Implementation of the Leadership, People, Process and Outcome Model of Lean using Soft Systems Methodology in Triangulation

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ABSTRACT

For decades, Lean has been viewed as an optimisation and process excellence philosophy that sets an organisation on the zenith in its industry through continuous process improvement and customer satisfaction when successfully implemented and sustained. However, attempts by some organisations to implement Lean has been fraught with overwhelming challenges due to the mode of implementation and the lack of understanding of the key drivers of the philosophy. This study investigates how different factors such as leadership, empowerment, motivation and organisational culture influence the successful implementation of Lean philosophy in organisations. The Soft Systems Methodology (SSM) in triangulation, an interactive, interpretive and systems based approach has been employed to analyse Lean as a system optimisation philosophy. This philosophy instils a culture of continuous commitment to waste elimination, process efficiency and effectiveness, consistent competency development, product improvement and customer satisfaction.

This Thesis presents the Lean 'Leadership, People, Process, Outcome' (LPPO) implementation model, that is flexible and easily adaptable. This model which shows measurable outcome and a drive for continuous improvement is system based, people driven and customer centred. The Lean LPPO model is theoretically built from existing models and practically tested in the fields through industrial based idiographic study.

The model used for Lean implementation identifies committed leadership, competent, empowered and motivated people and an organisational culture of continuous learning and improvement as the driving force of the Lean philosophy. It shows that the success of Lean

implementation and its sustenance in an organisation is based more on the social technical aspects and soft systems fabric of the organisation.

Using results from the industrial based study carried out with the Lean LPPO model within the soft system methodology in Triangulation from April 2010 to June 2011 in seven organisations; one in Europe, five in Nigeria and a cross-continental group; the relationships between the different identified factors were examined. The results revealed that the environment, leadership commitment, organisational culture, human resource competence, empowerment and motivation are directly related to the level of successful outcome from Lean implementation. These factors and the corresponding positive outcome also ensure the sustainability of Lean as a continuous improvement and optimisation philosophy in an organisation.

Keywords: Lean, Leadership, People, Continuous Improvement, Soft Systems Methodology, Organisational culture

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DECLARATION

Whilst registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award.

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ABBREVIATIONS

ENIC	Energy International Company
HRM	Human Resource Management
ILMM	Industrial Laundry Machine Manufacturing
IMVP	International Motor Vehicle Programme
JIT	Just-In-Time
LPPO	Leadership People Process Outcome
MIT	Massachusetts Institute of Technology
PDCA	Plan Do Check Action
PM	Preventive Maintenance
SPSS	Statistical Package for Social Science
SS	Senior Staff
SSM	Soft Systems Methodology
TMS	Top Management Staff
TPM	Total Preventive Maintenance
TPS	Toyota Production System
TQM	Total Quality Management
UK	United Kingdom
WIP	Work-In-Process

DEDICATION

To God

For sustaining me and making this a reality

To My Parents

For supporting this till the end

To My Brothers, Sisters and Family

This is done

To My Wife and Children

This is for you.

In memory of my son Ifunaya Ezeakwu Andrew Dibia 2010 – 2011

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to all those who were not so nice nor helpful, who am I to judge? Life is a system and situations are circumstantial, you gave me the will to succeed.

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DISSEMINATION

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Lean is a subjective construct for a continually improving cycle of effective and efficient optimisation of available resources which is dependent on the Human Resource. The use of the word 'LEAN' is subjective because any other word may have previously been used in the past, still being used today or could have been constructed and used to mean the same thing with similar philosophy at different time, in different era and in different environment within various diverse culture. Lean as a subjective term in connotations and industrial/academic dialectic meaning can be seen in its use as synonyms for TPS (Toyota Production System), JIT (Just-In-Time), CI (Continuous Improvement), JPM (Japanese Production Management) and even for QMS (Quality Management System) in terms of practice, ethics, processes, expectation, results and performance (Holweg, 2007; Schonberger, 2007; Shah & Ward, 2007; Shah & Ward, 2003; Monden, 1983; Hall, 1983a; Schonberger, 1982a).

The term lean production has its expression origin from the International Motor Vehicle Project research which was pivoted from the Massachusetts Institute of Technology, Boston, Massachusetts, United States of America. The expression 'lean production' was used to distinguish between mass production system as used in traditional western production lines and the repetitive manufacturing system modelled on the Japanese styled Toyota production system (Krafcik, 1988).

Interesting historical observations point towards the fact that many of the "lean" principles have in fact been applied throughout history. According to Hall (1983b), early evidence of

antecedents' to lean production can be found in the way the Venetians built ships at the time of the Crusades especially the fourth Crusade from 1202 to 1204. Even much earlier, similar "lean" principles in use was observed historically as the Roman army developed a system of continuous improvement both in building warships and in their military strategy in the battle field which made them distinct from any other army (Goldsworthy, 2003; Harkness, 2004; Carey et al., 2005).

Bicheno (1990) also points towards the Royal Navy during Nelson's time (1760-1780), which was able to match the 120-gun French and Spanish warships (battleships) with 74-gun ships (cruisers) simply because the Royal Navy not only practiced more than its opponent but also researched and disseminated these standardised operating procedures throughout the then very large fleet. Also, changeover reduction principles were instrumental for reloading the canons (Holweg, 2007). Hall (1983a) points towards the flow production line at Ford's Willow Run facility, where 6792 B-24 bomber planes were built during the Second World War, out of a total of 19,256 planes delivered to the U.S. Air Force. Womack and Jones also refer to Samuel Colt's concept of interchangeable parts and the early days of Henry Ford's synchronised flow as antecedents of lean production (Womack et al., 1990; Womack and Jones, 1996).

Today it is common to hear people ascribe the genesis of Lean production as a philosophy to Eiji Toyoda and Taiichi Ohno of Toyota, but the first step towards Lean production in the automobile industry was originally taken by Henry Ford in his first large plant in Highland Park in 1913. There, a set of practices and tools, interchangeable parts, standard work and assembly flow line was put in place in such an integrated way that allowed them to turn out products at incredible speed, with very short flow times and high consistency. But increased

demand for shorter product cycle and more variety, as well as the market demands after World War II, changed the competitive marketplace in such a way that Ford's early "Leanness" was not sustained in the long run (Holweg, 2007; Shah & Ward, 2007).

Historical evidence show that Lean as a philosophy went through great improvement and further development when two great Japanese executives from Toyota visited Ford Factories, Kiichiro Toyoda (member of the founding family of Toyota) and Taiichi Ohno (Toyota´s leading manufacturing engineer) visited Ford factories right after World War II and observed their operation. Their quest for improvement on what they have observed, with emphasis on workstation optimisation and unequalled ingenuity gave the world the Toyota Production System which is the bedrock of modern day "Lean". They developed the modern day Lean "mantra" as a philosophy of optimisation excellence and a proven practice that delivers real value.

Lean production system which originated from the Japanese styled Toyota production system (due to the post World War II scarcity of human and material resource and challenges of quality, variability, line balancing and inventory management) is a disciplined, process-oriented system which is focused on optimising the scarce human and material resources by identifying the major sources of waste, and then using tools such as Just-In-Time, 5S, Total quality management, production smoothing, setup reduction, Total preventive maintenance and others to eliminate the waste. This waste include, waste in overproduction, waiting time, transportation, unnecessary inventory, inappropriate processing, excess motion, defective products (the seven waste in physical production) and Quantitative and Qualitative underutilization of human resources (Dibia and Onuh, 2010).

Lean is a complete system that welds the activities of everyone from management to line workers, to suppliers, into a tightly integrated whole that can respond almost instantly to marketing demand from consumers (Womack et al., 1990). A Lean system is an integrated management system that emphasizes to a great extent the elimination of waste and the continuous improvement of operations for the optimisation of the benefits derived from its immediate use of scarce resources. A Lean system strives to synchronise production flow through continuous improvement and cross-functional integration (Adeleye and Yusuf, 2006). Lean practices enhance performance (Yusuf and Adeleye, 2002).

Lean is not what organisations need to do, but what organisations should become by effective system design and implementation (Cochrane, 2007). Todd (2000) defines lean production as an initiative whose goal is to reduce the waste in human effort, inventory, time to market, and manufacturing space to become highly responsive to customer demand while producing world class quality products in the most efficient and economic manner. It is an intellectual approach consisting of a system of measures and methods which when taken together have the potential to bring about a lean and therefore particularly competitive state in a company (Warnecke and Huser, 1995). Lean production is always associated with waste elimination. Such waste include those held in firms in the form of inventory or excess capacity (machine and human capacity) to ameliorate the effects of variability in supply, processing time, or demand (Shah and Ward, 2007). To manage and eliminate these wastes completely there is the need for a competent, flexible, dedicated, and engaging human resource that is capable of managing variability in supply, process time and demand (De Treville and Antonakis, 2006). Lean production is therefore an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing

or minimising supplier, customer and internal variability (Shah and Ward, 2007). The principles of eliminating this waste in organisations includes, the principle of specifying value, identifying the value stream, flow, pull and perfection (Womack and Jones, 2003).

Lean has long been seen as an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing suppliers, customer, and internal variability (Shah and Ward, 2007; Dibia and Onuh, 2010). The overriding purpose of adopting Lean as an agile system is to mobilise, shed off and reconfigure resource use at ease, in order to explore the endless windows of opportunities (Yusuf et al., 2003). Although Lean has been viewed as an integrated social technical system, evidence abounds in practice and in academic literatures that show implementation failure to be as a result of the neglect of the social-technical aspect of the process (Bamber and Dale, 2000; Emiliani, 2001; Emiliani and Stec, 2005; Parks, 2002; Stamm, 2004; Womack and Jones, 1994). In implementing lean using the soft systems methodology in Triangulation, this research looks at;

- The underlying issues for lean implementation,
- How lean initiative support the organisations systems optimisation from a practical point of view,
- The elements that are important in the implementation of lean,
- Ways/Models and tools for implementing lean.

Lean as a combination of technical and social system involves people who are the key social elements with the technical skills that make the system work (Shah and Ward, 2007; Shah and Ward, 2003; Poppendieck, 2002). Without the people, the human resource, nothing would work. In fact there will be no functional system.

With the 'people' as the fulcrum of lean implementation, the use of the soft systems methodology (SSM) as a method of ensuring successful implementation and sustenance became an objective option for consideration. The option of SSM is well suited for lean implementation as it is a system based approach to problem structuring and actions taken in ill-structured complex situations which has been developed through engagement with real-world problem situations (Checkland, 1999; Checkland and Scholes, 1990; Checkland and Poulter, 2006) (see Figure 1).

While the relationship between lean implementation and other factors have been the subject of prior research using various methods, this is the first look on Lean implementation using SSM in triangulation. Therefore, this research adds to the body of knowledge in this area. Also, existing Lean implementation models (Boyer, 1996; Sanchez and Perez, 2001) tend not to give direction on how to go and the sequence of intervention, this research would attempt to bridge the gap by developing a model for lean implementation which visually directs. Furthermore, this work presents the deployment of the developed lean implementation model using the soft systems methodology in Triangulation.

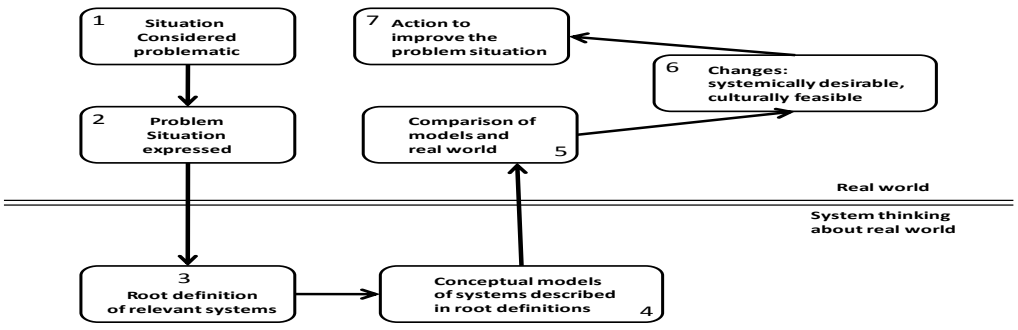

Figure 1. The Seven Stage Model of SSM (Checkland, 1981)

There are many reported works on Lean from many countries but there is none from the Nigerian Experience. This work further gives an insight into the Nigerian perspective from an idiographic point of view.

1.2 RESEARCH OBJECTIVE

This research is an action research with the purpose of taking a holistic look at the significant factors in the implementation of the Lean philosophy in organisations.

The main objective of this research is to develop a model which will serve as a cross industrial framework for the implementation of lean.

In addition, this research also seeks to establish a relationship between;

- The commitment shown by an organisation's leadership and the outcome in lean implementation.
- The commitment shown by an organisation's leadership and the motivation in a lean environment.
- The organisational culture and the outcome of lean implementation.
- A free interactive organisational culture and the staff motivation in a lean environment.
- The quality of the human resources (ability and competence) in an organisation and the level of outcome from lean implementation.
- Workers empowerment and process excellence in a lean environment.
- Staffs motivation and the organisations level of empowerment.
- The motivation of staffs and their ability and competence in a lean environment.

1.3 RESEARCH APPROACH

The study uses the Soft Systems Methodology (SSM) in Triangulation. The Soft Systems approach is used as it deals with the complexities of human affairs including management situations (Checkland, 1981; 1999; 2004; Checkland and Scholes, 1990) which are clearly suited for this study involving series of actual deployment of lean with the purpose of taking a holistic look at the significant factors and the complexities in the process of lean implementation and the model validation. This approach entails multiple methods, both qualitative and quantitative and multiple levels of data collection and analysis embedded in the SSM enquiry approach (see Figure 2). The qualitative method include, existing research literature content analysis, ideographic field observation, case study and semi-structured interviews carried out as integral parts of the Lean research using Peter Checkland's Soft Systems Methodology. The quantitative method involved the use of questionnaire with factual analysis of the response using the Statistical Package for the Social Sciences (SPSS) also known as the Predictive Analytics Software (PASW).

The Soft Systems Methodology by Peter Checkland was used in this research since this is an action research which takes a holistic view within the boundaries and environment in which the system of interest resides. Peter Checkland's soft systems methodology is best suited for this research as it clearly shows the process which is used for the enquiry and also present the facts as they are in a complex social system. These facts as observed are supported with information gathered from questionnaires and interviews.

The Soft System Methodology constitutes a seven stage inquiry process which starts with an initial appreciation and expression of the situation using one or more rich pictures, followed by the definition of a number of 'human activity systems' thought to be relevant to the

situation of concern (Checkland, 1981; Checkland and Scholes, 1999). These human activity systems are given a formal 'root definition' which is a declaration of the purpose of the system. What need to be done next is to select a particular perspective and put it through a very structured and rigorous model development process developed by Peter Checkland using the mnemonic CATWOE.

- **C**ustomer (Beneficiaries): Everyone who benefits or lose from the output of the system such as the company, its market, its local community etc.
- **A**ctor: The actors perform the activities defined in the system. Actors could include staff, management, etc.
- **T**ransformation: Process of conversion of inputs to output.
- **W**eltanschauung: German expression for world view. This world view makes the transformation process meaningful in context.
- **O**wner: Every system has some proprietor, who has the power to start up and shut down the system.
- **E**nvironmental constraints: These are external elements which exist outside the system which it takes as given. These constraints include organisational, national and international policies and standards as well as legal and ethical matters.

Clarity gained by addressing these key perspectives separately and understanding their implications is then used in building the conceptual model and comparison is then made between the first rich picture and the conceptual model. The understanding of the possibilities and limitations from this comparison is then used to define a desirable and feasible change model for the implementation of lean from the existing environmental and organisational perspective of the company. Finally, an analysis of the system is carried out

and recommendations made on action that are needed to be taken. Evaluative conclusions are finally drawn from the findings, observations and results from interviews and questionnaires analysed.

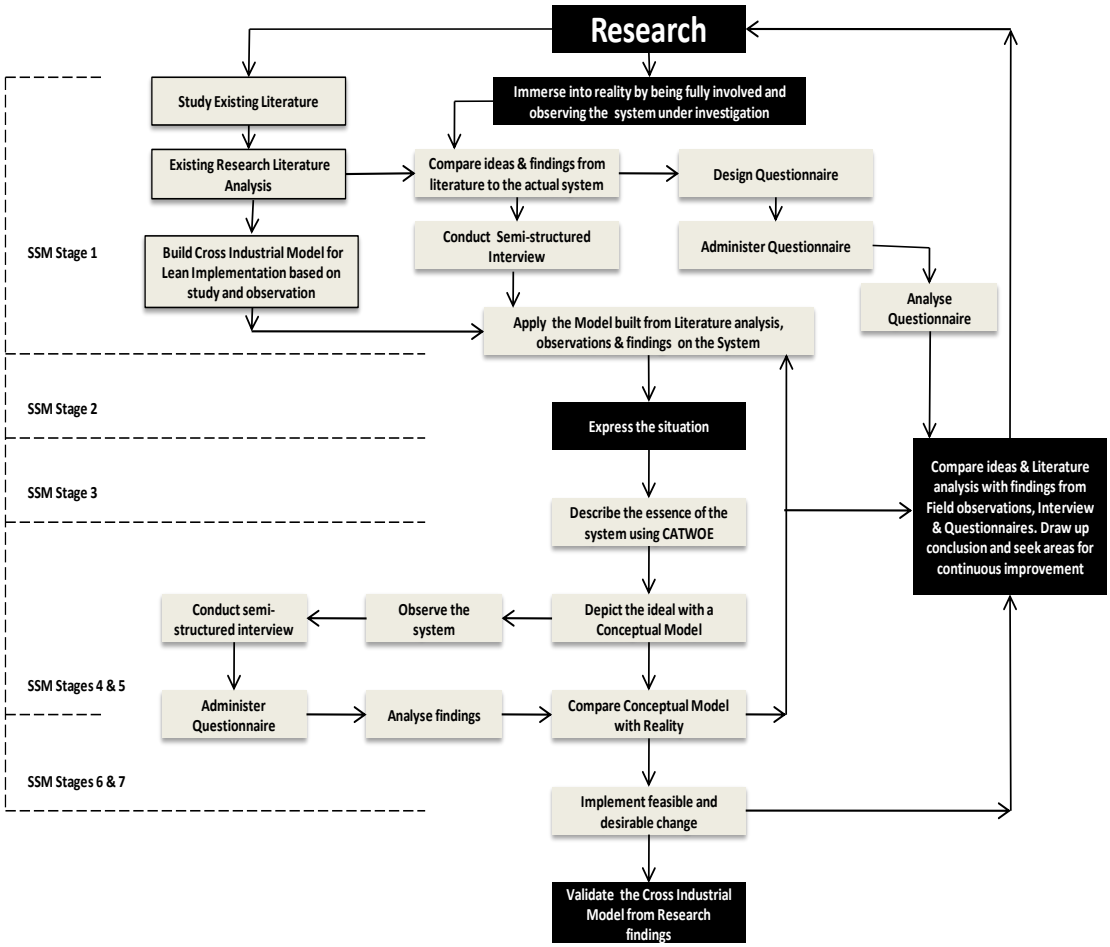

Figure 2. Soft Systems Methodology in Triangulation Design for the Research

1.4 SCOPE AND LIMITATIONS OF THE RESEARCH

The industrial based ideographic aspect which entails immersed observation had its limitations and challenges as the confidentiality of the organisations had to be protected from the legal point of view and also to wade off the praying eyes of competitors who may get ideas of the trade secrets of their competitive advantage or the challenges they face

from their possible weaknesses. To this regards, all organisations used for this research are referred to in assumed names for confidentiality purpose.

The scope of this study was limited to organisations that expressly invited the researcher to be part of their Lean implementation process. These were organisations that prior to the study was about to deploy lean in its system or was already practicing lean as a philosophical part of their long term business strategy.

1.5 THESIS OUTLINE

This thesis consists of nine chapters. A brief overview of the content of each chapter is as follows:

Chapter One outlines the background of the research, with the research objective stated. The chapter further presents the research approach design and also gives information on the thesis outline and the scope and limitation of the research.

Chapter Two presents the literature review. It looks at the actual lean practice and presents the views of lean researchers and current practitioners.

Chapter Three looks at the questions arising from the literature reviewed on which bases the research survey questionnaire was developed.

Chapter Four shows the development of a cross industrial model from comprehensive literature review.

Chapter Five outlines the research methodology adopted for this study explaining in details the approach taken in the collection of both qualitative and quantitative data.

Chapter Six presents the Action Research showing the various case studies used in this research with the introduction of the organisations and groups. The semi-structured interview conducted in some of the organisations is also reported with a participatory observation analysis carried out using the soft systems methodology.

Chapter Seven presents the analysis of the interviews conducted during the Action research.

Chapter Eight presents the survey results and analysis of the result.

Chapter Nine discusses the research and results obtained.

Chapter Ten is a conclusion drawn from the research findings with recommendations made for future study.

1.6 SUMMARY

The chapter one of this thesis has presented a concise overview of this research giving a brief highlight of its constituent parts. It introduces the research with a full background study of the optimisation concepts in Lean and the history behind the Lean philosophy. The definition of Lean from various scholars and industrial practitioners are also given in this Chapter one. In this chapter the research objectives with the intended approach to be adopted for the study are also stated. Finally, the scope of the research, expected limitations, and details of the thesis outline are clearly stated.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Lean in its original form is an improved version of Taiichi Ohno's Toyota Production System which was a more efficient adaptation of Henry Ford's continuous flow sequence. Ford was also inspired by Colt's rifle factory in Hertford back on 1855. So it is obvious that the idea of continuous flow and improvement has a long history (Bicheno and Holweg, 2009) although it is not a single straight point invention, but the outcome of dynamic learning process and adapted practices emanating from the automotive and textile sectors in response to environmental contingencies in Japan at the time (Cusumano, 1985; Fujimoto, 1999; Holweg, 2006) and in various other industries at later times and even in the world today.

According to Liker (1996), Lean is "a philosophy that when implemented reduces the time from customer order to delivery by eliminating sources of waste in the production flow". It is a managerial philosophy and a set of integrated socio-technical practices aimed at eliminating waste along the whole value chain within and across companies (Furlan et al., 2011; Holweg, 2007; Womack et al., 1990). Lean is doing more with less resources, It is a complete system that welds the activities of everyone from management to line workers, to suppliers, into a tightly integrated whole that can respond almost instantly to marketing demand from consumers (Womack et al., 1990). Lean production is an integrated management system that emphasizes to a great extent the elimination of waste and the continuous improvement of operations for the optimisation of the benefits derived from its immediate use of scarce resources. Lean is not what organisations need to do, but what organisations should become by effective system design and implementation (Cochrane, 2007). Todd (2000) defines lean production as an initiative whose goal is to reduce the

waste in human effort, inventory, time to market, and manufacturing space to become highly responsive to customer demand while producing world class quality products in the most efficient and economic manner. It is an intellectual approach consisting of a system of measures and methods which when taken together have the potential to bring about a lean and therefore particularly competitive state in a company (Warnecke and Huser, 1995). Lean production is always associated with waste elimination. Such waste include those held in firms in the form of inventory or excess capacity (machine and human capacity) to ameliorate the effects of variability in supply, processing time, or demand (Shah and Ward, 2007). To manage and eliminate these wastes completely there is the need for a competent, flexible, dedicated, and engaging human resource that is capable of managing variability in supply, process time and demand (De Treville and Antonakis, 2006). Lean production is therefore an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer and internal variability (Shah and Ward, 2007). The principles of eliminating this waste in organisations includes, the principle of specifying value, identifying the value stream, flow, pull and perfection (Womack and Jones, 2003).

2.2 LEAN FROM RESEARCHERS PERSPECTIVE

Lean is a subjective construct for excellence in system management and continuous improvement in processes. It is a concept for best practice. The word lean as used in operations and systems management originated from the Toyota production system (TPS) and its Just-in-time (JIT) concept. From the first paper on TPS published by Ohno in collaboration with other members of the Toyota Company (Ohno and Kumagai, 1980; Sugimori et al., 1977a, b) to Yasuhiro Monden's articles in the Industrial Engineering Journal

(Monden, 1981 a, c, b), Lean, TPS or JIT has all been viewed as a business excellence process of continuous improvement. Other early writers on aspects of the lean philosophy include Schonberger (1982b, c, 1983a, and b) and Hall (1983). They played a major role in disseminating the JIT message in the Western world (Holweg, 2007).

Writers and researchers from various backgrounds have also looked at lean from varying perspective. Womack, Jones and Roos (1990) gave the world a book titled 'The machine that changed the world' which fully introduced the concept of Lean as a world class process for business excellence. The 'machine' book in its first page listed the principles of Lean to include; Teamwork, Communication, Efficient use of resources and elimination of waste, and Continuous improvement. In its comparison of Lean as a production system to the mass production it opined that Lean required;

- Half the human effort,
- Half the manufacturing space,
- Half the investment tools,
- Half the engineering or work hours,
- Half the time to develop new products compared to the requirement for mass production (Womack et al., 1990).

The core issues that led to the competitive advantage that the Lean philosophy brought was viewed by the 'machine' book from;

- Leadership commitment, sincere people management and human resource development,
- Product development and engineering,

- Supplier management,
- Customer management.

The book was based on the international motor vehicle programme (IMVP) five year research of the Massachusetts Institute of Technology (MIT) which saw the researchers study seventy (70) assembly plants in the automotive industries of fourteen (14) countries (Holweg, 2007; Womack et al., 1990). The research was carried out to unravel the reason or reasons for the performance gap between Japan and the Western automotive industries. The findings showed that the performance gap was due to the philosophy behind the production system used. It was more of excellence in continuously improving process management and not due to geographical location.

Womack and Jones (1996) extended their thought from their experience during the MIT international motor vehicle research and concluded that there were five basic principles for reducing waste and building a lean system. The principles are;

- Specify the value (product or service),
- Identify the value stream,
- Let the value flow without any interruption,
- The customer pulls the value,
- The organisation continuously pursues perfection by continuous improvement.

Womack and Jones (1996) five principles of lean describes value and the value adding processes unencumbered by waste (non-value adding activities) (Lamming, 1996). It sees value and its stream from a total view of the process 'from raw material source to end

consumer and possibly beyond through recycling of the material back into the system (Lamming, 1996).

Schonberger (2007) termed the excellent production and process management system detailed by Womack, Jones and Roos (1990) that "wreaked havoc" on the western competition in the automobile industry in the 1970s and 1980s as the Japanese production management system. It was lean. It had mutually reinforcing set of best practices in the area of employee involvement, attention to quality and just-in-time (JIT) with such elements as quick set-up, small lots, cells and kanban.

Liker (2004) saw lean as the Toyota way based on fourteen (14) principles which include;

- A long-term philosophy,
- Creation of continuous process flow to bring problems to the surface,
- Use of pull system to avoid overproduction,
- Levelling out the workload (heijunka),
- A culture of stopping to fix problem and getting quality right the first time,
- Having standardised tasks which allow for employee empowerment and continuous improvement,
- Using visual controls which allow for easy identification of problems,
- Use of tested and excellent technology that serves the people and the process,
- Grow leaders with the philosophy in their heart, their soul and their ways,
- Develop exceptional people and teams,
- Respect for people including the network of suppliers,
- Thorough understanding of the situation by 'go see (genchi genbutsu),

- Make decision slowly by consulting the process owners on the work floor and thoroughly considering all option before implementing decisions rapidly,
- A continuously learning organisation that reflects (hansei) and continuously improves (kaizen).

Liker (2008) further expressed his thought on Lean from the Toyota perspective as a culture which is the heart and soul of a continuously improving system.

Shah and Ward (2003) bundled the Lean culture and practice (which they listed as twenty two (22) manufacturing practices) of excellent product and process management as expressed by earlier authors into four key facets of inter-related and internally consistent practices (Mo, 2009) of Just-in-time (JIT), Total quality management (TQM), Total preventive maintenance (TPM) and human resource management (HRM) (Shah and Ward, 2003). Shah and Ward (2003) showed from their research that these bundles are conceptually, theoretically and empirically well established.

The JIT principle from Shah and Ward perspective basically ensures a continuous reduction and ultimately elimination of all forms of process waste from work-in-process (WIP) inventory and unnecessary delays in flow time (Shah and Ward, 2003). From the twenty two (22) individual lean practices listed by Shah and Ward (2003), all practices related to production flow were combined to form the JIT bundle. The practices include quick changeover, cycle time reduction, lot size reduction, bottleneck removal, reengineering production processes and implementing cellular layout.

The TQM bundle included all practices related to quality sustainability and continuous improvement in the various processes within the system while the TPM bundle focuses on

the optimal and effective use of equipment through planned predictive and preventive maintenance system (Shah and Ward, 2003).

The final bundle from Shah and Ward (2003) focuses on the HRM. The HRM is the people factor. It entails the effective and efficient management of the people in the constant elimination of process waste and optimal utilization of all available resources. The HRM bundle from Shah and Ward (2003) perspective includes the two higher level HRM practices of flexible cross functional work force and self directed work teams.

Holweg (2007) in 'the genealogy of lean production' a literature that looks in details on the reason for the success of 'the machine that changed the world' by Womack, Jones and Roos, concluded after iterating series of interviews with key authors and researchers that the Leadership determines the Leanness of an organisation. Ideally, the management sets a clear vision for improvement in any organisation. Therefore the management as the Leadership team is essentially the decisive element in the system that determines whether the organisation would "become a Toyota (Lean)" or not (Holweg, 2007).

Viewing lean from key researchers' perspective has thus brought to the fore elements or prerequisites for a functional lean organisation. Historically, key researchers have viewed the essential element needed for the success of a Lean system from diverse perspectives (see Table 1).

Time line	Author(s)	Perception on the constituent of the Lean philosophy
1977a,b.	Sugimori et al.	Just-in-time and respect for human system
1980	Ohno and Kumagai	Just-in-time and respect for human system
1981a,b,c.	Monden	Just-in-time
1982a,b,c,	Schonberger	Just-in-time
1983a,b.	Hall	Just-in-time (JIT) and zero inventories
1983a,b.	Schonberger	JIT, Quality and Work improvement
1987	Shimada and MacDuffie	JIT and strategic Human resource management
1988	Ohno	JIT and respect for people
1988	Krafcik	JIT, Quality, Flexibility and respect for people
1990	Womack et al.	Leadership, Teamwork, Communication, Efficient use of resources, Continuous improvement, Suppliers management and Customer management.
1996	Womack and Jones	Value, Efficient value stream flow, Customer pull system and pursuit of perfection
2003	Fullerton	JIT, TQM and Cellular manufacturing
2003	Shah and Ward	JIT, TQM, TPM and HRM
2004	Liker	Long term philosophy, Excellent process flow, Pull system, Quality, Employee empowerment, Continuous improvement, Culture, Visual Control, Respect for people (including suppliers), Leadership, Teams and Continuous Learning.
2007	Schonberger	Employee involvement, Quality, JIT
2007	Holweg	Leadership and Clear Vision
2008	Liker	Culture and Continuous improvement

Table 1. Key researchers views on the constituent elements of the Lean philosophy.

These elements identified by the key researchers can be further classified into four major themes of Leadership, People, Process and Outcome (see Table 2).

Lean major theme	Elements	Author(s)
Leadership	Leadership, Vision, Long term philosophy, Respect for people, Effective communication	Holweg, 2007; Krafcik, 1988; Liker, 2004; Ohno, 1988; Ohno and Kumagai, 1980; Sugimori et al., 1977a, b; Womack et al., 1990.
People	Empowerment, Respect for people, Multifunctional teams, Culture and attitude, HRM, Suppliers and Customer management	Krafcik, 1988; Liker, 2004; Liker, 2008; Ohno, 1988; Ohno and Kumagai, 1980; Schonberger, 2007; Shah and Ward, 2003; Shimada and MacDuffie, 1987; Sugimori et al., 1977a, b; Womack et al., 1990.
Process	JIT, Value stream process flow, Customer pull process, Continuous improvement and Visual control.	Fullerton, 2003; Hall, 1983a, b; Krafcik, 1988; Liker, 2004; Liker, 2008; Monden, 1981a, b, c; Ohno, 1988; Ohno and Kumagai, 1980; Schonberger, 1982a, b, c; Schonberger, 1983a, b; Schonberger, 2007; Shah and Ward, 2003; Shimada and MacDuffie, 1987; Sugimori et al., 1977a, b; Womack et al., 1990; Womack and Jones, 1996.
Outcome	Quality, Efficiency, Effectiveness, Satisfaction	Krafcik, 1988; Liker, 2004; Liker, 2008; Schonberger, 1983a, b; Schonberger, 2007; Shah and Ward, 2003; Womack et al., 1990; Womack and Jones, 1996.

Table 2. Leadership, People, Process and Outcome, major theme from Lean researchers

The four major themes of Leadership, People, Process and Outcome and their subsequent elements identified from the key researchers will be looked into in details.

2.3 LEADERSHIP

Leadership is a process, by which an individual socially influences, inspirationally motivates, aid and support others in the accomplishment of a common goal (Chemers, 2002). The individual who is otherwise a role model may have and exudes such influence and

motivation due to his or her beliefs or values exhibited. In terms of styles, Leadership can be Autocratic, Participative or Laissez-Faire (Bass, 1990). Autocratic leadership style has a centralized decision making system which has dictatorial tendencies. Autocrats are action-oriented and doers (Dyer, 1986). Participative leadership style is democratic in nature as decisions are taken after full consultation of the group. Participative leadership style builds understanding and cohesive teamwork and also enriches work (Bass, 1990). The Laissez-faire or free rein leadership style leaves the people 'fully on their own'. They are allowed total freedom as subordinates to take decisions. In this case the leader does not actually lead. Leadership from the Lean philosophy and perspective gives direction. It involves coaching, stimulating organisation wide participation and employee empowerment (Emiliani, 2003).

Leadership and its theories are associated with the belief that variance in a firm's performance can be associated with the leadership qualities of its top managers (Gudmundsson, 2004). The arguments seems more visible using human capital theory in small organisations as a considerable proportion of variance in their organisational activities and outcomes could be associated with individuals (Preisendorfer and Voss, 1990).

It has also been argued that leadership typically involves a more complex mix of behavioural, cognitive, and social skills that may develop at different rates and require different learning experiences (Lord and Hall, 2005; Day and Halpin, 2004; Zaccaro and Klimoski, 2001; Mumford et al., 2000). Leadership is very essential in the implementation of lean as it is a key human aspect that determines the success or failure of any venture, be it in government, business, sports or even the family system. Historically, Leadership has been a subject of speeches, writings, theories and discussions from Plato's philosophical

writings to Womack's speeches, seminars and discussions. Various theories and styles of leadership have developed over time. Theories such as

- The Trait theory of leadership which gradually started its historical development in the 19th century as 'Great Man Leadership theory' has the idea that leadership is based on individual attributes (Chemers, 2000; House and Aditya, 1997; Judge et al., 2002; Kirkpatrick and Locke, 1991).
- The behavioural and style theories which insist that a high level of self-confidence and self esteem is very important for anyone who can be deemed fit to lead (Chemers, 2000)
- The situational and contingency theories: Here social scientists argue that the times produce the person (the hero, the leader) and not the other way round. It means that different situations and era calls for different type or situational unique type of leaders (Chemers, 2000).
- Functional leadership: leadership based on organisational unit effectiveness (Bass and Bass, 2008).
- Transactional and transformational theories: Having the power and ability to motivate a team to be effective and efficient (Bass 1985; Burns, 1979; Chemers, 2000; Chemers, 2002).
- Neo-emergent theory: Theory built from oxford school of leadership base on the idea that leadership is created through the emergence of information by the leader and not through action as the reproduction of these stories in terms of information dissemination which tend to stand as a means of authority helps to create the perception of leadership by the majority (Chendroyaperumal, 2011).

- The Environmental leadership theory: This theory is based on the philosophy of cultivating an environment that brings out the best and inspires the individuals within a group (Bass and Bass, 2008).

Leadership as a functional system has moved from a supervisory role to a strategic management role. This has lead to the development of relevant groups of theories for leadership such as the charismatic theories, the transformational theories and the visionary theories of leadership (Boal and Hooijberg, 2000). The key difference between these new theories that are focused on strategic leadership and the earlier supervisory theories of leadership is that the "supervisory theories of leadership focus on task and person oriented behaviours of leaders as they attempt to provide guidance, support, and feedback to subordinates, while strategic leadership theories of leadership which is the new trend of leadership focuses on the creation of meaning and purpose for the organisation with the centre of focus being the people who have overall responsibility for the organisation" (Boal and Hooijberg, 2000; House and Aditya, 1997).

Strategic leadership is associated with activities such as making strategic decisions, creating and communicating a vision of the future to the people, developing key competencies and capabilities within, developing efficient and effective organisational structures, processes, and controls, managing multiple constituencies, selecting and developing the next generation of leaders, developing and sustaining an effective organisational culture, and infusing ethical value systems into the organisation's culture (Boal and Hooijberg, 2000; Hickman, 1998; House and Aditya, 1997; Ireland and Hitt, 2005). These strategic leadership traits must be exhibited by the top management team in any organisation implementing the Lean philosophy.

Just as there are actual and scholarly agreements from numerous research that the commitment of senior management is essential to the implementation of Lean production system (Savolainen, 2000; Heymans, 2002; Swank, 2003; Waters and Bevan, 2005; Found and Harvey, 2006 and 2007), it has also been proven over time that the leadership within the system is a determinant factor in the implementation of lean and its sustainability (Emiliani, 2003; Lucey et al., 2005; Found and Harvey, 2006 and 2007; Van Dun et al., 2008; Fine et al., 2008). While leaders foster change and create an enabling environment to institutionalise this change, managers stabilize the organisation and ensure that the changes are properly implemented to guarantee the desired outcome (Found et. al., 2009).

To be able to optimise the human resource in the implementation of the Lean production concept, it essential that there is full commitment from the leadership and a clear vision which must be well communicated to the human resource which are the people who make things work. They are the people that will make this vision a reality with total commitment and hard work.

2.3.1 Vision and Commitment

To be able to successfully implement lean the organisation must have a clear vision of where they want to be. What their goals and objectives are and how their current activities and actions currently align with their vision. The Leadership (top management) is the decisive element in the system determining whether the organisation would become lean or not, hence they set a clear vision of where they want to be and how they want to go (Holweg, 2007). The Leadership of the organization that intends to implement lean must show a strong commitment to achieve the intent of the implementation and also sustain these improvements by entrenching a culture of continuous improvement. The Top

management must sponsor and champion the implementation and entrenchment of Lean as continuous improvement process for it to be successful in any organisation because without this support there is every tendency for the process to fail and this will defeat the aim of implementing lean which is to succeed by continuously improving the business process through optimisation of the available resources (which includes materials, human, machines, finance and time).

2.3.2 Long term philosophy

Implementing Lean and getting the benefits from the implementation is not a quick fix process. Implementing and sustaining the benefits of lean takes time with a long term commitment based on management decision on lean as a long-term organisation wide philosophy. Implementing lean requires a philosophical sense of purpose that supersedes any short-term decision making for short term financial gains (Liker, 2004). The organisation must generate real value for the customer, society and the economy (Liker, 2004). It should work, grow and align itself towards the common purpose of process waste elimination, efficient and optimised productivity, quality output, customer satisfaction and continuous improvement that is bigger than making immediate money (Liker, 2004).

Lean is a people centred philosophy. As a people based philosophy, it must be conceptualised, tested and implemented with commitment and dedication for it to be workable and for the success to be visible, felt and sustained. It needs time to be well understood by the people and the immediate operators. It takes time for it to be fully built into the system as a philosophy and be actively accepted by the people as a culture. The skills needed to continuously add value must be constantly maintained and improved to

sustain the continuous improvement philosophy of Lean. Lean should be a long term philosophy if it must be sustained.

2.3.3 Respect for People

Respect for people can be conceptualised as the glue that holds the other lean production philosophical elements and dimensions together (de Treville and Antonakis, 2006). The objective is to reduce alienation through expressing respect, recognition and appreciation (de Treville and Antonakis, 2006). The employees must be able to fully identify with the companies goals and aspirations, there must also be a firm cohesion among employees. There should be a sense of belonging among staff; they should have the opportunity to perform their duty well for the success of the organisation. They should be given the means and time to do what it takes for the optimal benefit of the system. Their opinion should be listened to as their suggestions are needed for the improvement of the system since they see, walk and work the process. The people are responsible for production, rendering services, problem solving and improvement (Duclos, et al. 1995). The process, the system and the organisation belong to the people in a lean enterprise and there respect is a must if the gains must be sustained.

Respect for people begins by giving the worker the training and equipment required for the expected level of performance (Adler, 1993; Monden, 1983; Womack et al., 1990). It entails the payment of the workers a competitive wage (de Treville and Antonakis, 2006). It is also respectful and motivating for workers opinion to be listened to and possibly put into productive use. Management respect for its workers in lean can be seen in the transfer of certain types of authority and responsibility (such as trouble-shooting, equipment maintenance, statistical quality control and inspection) to the lower cadre of the

organisation (Boyer, 1996; MacDuffie, 1995). Disrespecting people creates waste (Emiliani and Stec, 2005) as they would be underutilized and would not put in their best where necessary.

2.3.4 Effective communication

Communication is an important aspect of the Lean philosophical process (Puvanasvaran et al., 2009). Effective operation of the Lean philosophy requires clear communication, not only between operational units, but also between all segments of the value stream (Storch and Lim, 1999). Within operational units communication ensures productivity and quality and also prevents any form of resentment between workers (Hancock and Zayko, 1998). Externally, it allows the value to flow seamlessly from the suppliers through the production or service process to the customer. Lean implementation succeeds when the leadership coordinates the lean process deployment through rich communication. The communication pathways must be efficient and broad (Jenner, 1998).

The communication system should also allow for direct information flow to the decision maker thus ensuring that the information is acted upon just in time. A rich, efficient and broad communication system allows for rapid flow of information, quick feedback and immediate corrective action. At Toyota which is a leading example of 'true lean', communicating about set of problems, concerns, and solutions, appears to increase the richness of communication while decreasing the length of time spent on corrective or illustrative meetings (Mohanty et al., 2006).

Effective communication drives behaviour in lean. Communication may be verbal (direct) or visual. Managers require activators to enable them motivate their workforce to engage in the behaviour that drive productivity (Parry and Turner, 2006). Lean utilizes clear visual

communication tools such as tables, text, electronic messages, audio signals, graphs, pictures, posters, symbols and colour coding to fulfil this role (Bilalis et al., 2002). Every person involved in the process must be able to see and fully understand what each visual tool or signal signifies at any time, as the visual tools form an important part of the communication process which drives the lean enterprise (Parry and Turner, 2006).

Communication is also necessary for giving direction and for motivation by expressing outcome. In implementing lean it is essential that small wins are communicated from the onset so that people's attention can be drawn to the successes of better outcome, better performance, better process, time savings, better quality and better resource utilization as they unfold.

2.4 PEOPLE

Lean as an agile process is all about leveraging people and information (Gunasekaran and Yusuf, 2002). People are an essential part of the lean philosophy and culture (Liker, 2004; Mann, 2005; Veech, 2004). The term 'people' from the lean perspective include the workers, investors, suppliers, customers and the community all regarded as valuable resources to which a business owes its existence (Emiliani and Stec, 2005). In Lean production system, it is all about the people. According to Mann (2005), "Focus on the people and the results will follow, focus on the results, and you will have the same troubles as everyone else; poor follow-up, lack of interest, no ownership of improvements, diminishing productivity". Lean is an organisation's continuous improvement process in which the people play the central role in its deployment, implementation and sustenance. The people are key both from the suppliers point of view through the business processes to the customers perception of satisfaction, these are all point of people interaction with the

system that determines success or failure of the various business processes which lean seeks to optimise. As a social-technical system, the people are seen as the key resource which drives other resources. This means that the behaviour exhibited and the competence shown by the people who are actually the workforce within and outside organisation are key to the successful deployment and implementation of Lean.

Lean researchers from literature reviewed (see Table 2) saw the people element of lean to include; empowerment and a culture of respect, teamwork, customer care and suppliers management entrenched by the organisation through the strategic lean bundle of human resource management. A brief literature study of these elements of lean would be carried out.

2.4.1 Empowerment

Lean as a system that guarantees process excellence driven by its people must have empowered people to ensure successful implementation and sustenance. Boyer (1996) defines empowerment as giving workers more responsibility and control of the manufacturing, production or service process. Empowerment entails having the necessary knowledge, skill and authority to perform and knowing what is expected from the required actions in performance. Empowering the people in a lean enterprise also involves training and development, provision of adequate time and means to carry out the job, provision of the right work environment and adequate compensation for the job done.

Empowerment is the right or power given or acquired to take initiative and make decisions. It is given when it is sanctioned or derived from official or legal authorisation. It is acquired from knowledge gained from consistent training and development. Acquired empowerment is based on the fact that attending training or beings trained for knowledge and skills

creates opportunity for the workers and also motivates them to perform. Being empowered creates responsibility and accountability for the Lean team whose Job it is to ensure performance by improving the process. Acquired knowledge gained from continuous training and development could be termed intrinsic as acquired knowledge backed with the required skill to perform gives the average worker confidence which is a key intrinsic empowerment to perform at all time by ensuring that jobs are performed right the first time. You can only always do it right the first time if you know exactly what to do. Always knowing what to do is in itself an intrinsic empowerment because with you doing it, nothing goes wrong as all is done right the first time which is one of the fundamental tenets of Lean 'do it right the first time'. Doing it right the first time eliminates the waste of defect and waiting (for it to be done again).

Being informed or regularly being given access to information for decision making in solving problem or improving services rendered also empowers the individual or the team to perform. Blanchard, Carlos and Randolph (2001) identified three keys which managers must use to empower their employees. These keys are; sharing information with everyone, identifying and creating autonomy through boundaries and replacing the old hierarchy with self managed teams. These three identified empowerment keys do not just give power to people, but the keys tend to release employees knowledge, experience and motivation which they already have that are fundamental in deploying and sustaining Lean (Blanchard et al., 2001).

Empowerment decentralizes power, giving authority for making general delivery or production related decision to the shop floor or service front line. Empowerment ensures full engaging participation for employees during deployment of Lean in their various

processes which gives a sense of ownership as they are empowered to feel 'the process is mine so I must continuously make it better and safer for me to work'.

2.4.2 Culture

Culture is the social energy that drives the firm which exerts a vital influence on performance (Ireland and Hitt, 2005). It is the shared belief system within the organisation (Sathe, 1983). It is the sum of peoples' habits related to how they get their work done (Mann, 2005). It is the widely shared core values (Peters and Waterman, 1982). According to Daft (2001), "an organisation's culture is the set of values, guiding beliefs, understandings and ways of thinking shared by members of an organisation and taught to new members as correct". This view is shared by Schein (2004) who also define culture as "a pattern of shared basic assumptions that has been learnt whist solving problems that has worked well enough to be considered valid and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems". Culture is multi-layered and is rooted in deeply held assumptions and can either support or impede a company's ability to learn and be truly lean (Liker, 2008). Contemporary lean organisation leaders have continued the tradition of developing internal culture focused on continuous improvement and respect for people and intensely focusing on making positive contribution that would always satisfy the customer, eliminate waste and sustain the organisation in its business environment and the world at large (Liker, 2008). Lean is a culture that empowers, builds effective internal multifunctional teams and external value stream teams from the supplier to the customer. It is a culture that ensures a continuous learning attitude for a continuous improving process. It an organisation's way (Liker, 2004) entrenched by its human resource management. Lean is a culture of continuous respect for its people shown by;

- Building confidence in them by constant training and development which empowers and intrinsically motivates,
- Ensuring that only the best fits are selected to do what they can do in increasing productivity and adding value to the system and also getting better in their chosen field.
- A culture that ensures that the right recognition is given and compensation is paid for continuous improvement contributions made and job done.

Liker (2008) reiterated that people are the heart and soul of the Lean way. They entrench and sustain the Lean culture of quality, optimisation, process waste elimination and continuous improvement. This culture should be based on long term thinking, commitment, collectivism and teamwork where the individual is subordinate to the group. It involves a day to day and hour to hour way to move from the norm to 'the Lean way', from mass or batch philosophy to Lean. Bhasin and Burcher (2006) opined that in changing the corporate culture to Lean, there is a need to;

- Make decisions at the lowest level,
- Have a clearly defined vision, what the organisation would look like when the transformation is complete,
- Ensure there is a strategy for communicating the change needed to achieve the goals,
- Assign leadership and other responsibilities for the initial pilot programmes and ultimately within the whole organisation in the long run,
- Develop long term suppliers relationships based on mutual trust and commitment,

- Nurture a continuous learning environment through informal work base and formal professional training,
- Be a customer focused organisation,
- Maximise stability in the environment by attempting to reduce schedule changes, program restructures and procurement quantity changes.

Creating a lean culture involves discipline, daily accountability process and visual control (Mann, 2005). The inputs for a lean culture are;

1. Building the philosophy,
2. Instilling the values,
3. Commitment, leadership and empowerment,
4. Creating internal and external teams and partnerships,
5. Continuously building waste free processes that are consistent and sustainable, and
6. A consistent human resource management mechanism that ensures continuous flow and availability of competent people.

This consistent human resource management mechanism involves the people value stream of quality people producing high quality, low-cost, and on-time products (Liker, 2008). The value added steps in this value stream of people sustaining culture for lean include;

- Attracting people with the knowledge, skill, experience and ability who are trainable and can contribute to the value-adding processes.
- Developing those people so that they know what is expected of them and have the capability to do that which is expected of them at the highest level of consistency and accuracy producing quality products and rendering quality services every day.

- Engaging the people by empowering them to optimise their intellectual capacity by going beyond doing the work to improving how the work is done through rigorous problem solving.
- Inspiring the people by intrinsically, psychologically and physically motivating them so that they are committed to the organisation and will continue to learn, grow, and do their best for the customer, community, and society (Liker, 2008).

With good leadership and commitment and with a high level of consistency in having the right people, a right process is built and a culture is sustained.

2.5 PROCESS

The right process will produce the right results (Liker, 2004). Processes are designed sequences of tasks aimed at creating value-adding transformations of inputs (material and information) to achieve intended outputs (Upton, 1996). The process starts with activity planning, this must be well thought off and well organised. It must be precise and each step should be logically sequential so as to achieve the desired result. It looks at the activities, the expected flow of communication (which is a major determining aspect of success) during these activities, the available financial, material and human resources compared to what is needed for these activities and possible challenges that might be encountered during these activities. At the activity planning stage the team may decide to adopt some form of methodology that will ensure orderly investigation into the system for improvement. Lean process methodology such as DMAIC (Define, Measure, Analyse, Improve (expected), and Control (to be put in place)) could be deployed for the activity planning. After laying out the Lean implementation plan for the process stage of the model, the next stage is to work the process to see the value stream of the existing process.

2.5.1 Value Stream Analysis

According to Womack and Jones (1996), working and thinking in the Lean way helps an organisation to identify its value stream, eliminate the waste in its process and generate a flow of value to the customer. Value is what the customer wants; it is what the customer pays for; so, value is defined by the customer. The Value stream is the flow of value (as defined by the customer) from the supplier to the customer. It is all the actions both value added and non-value added that is required to bring a product through the main flows of material (to finish product for customers) and design (from concept to launch) to the end point where the customer want it (Rother and Shook, 2003). The Value stream can be represented by a process flow diagram or more appropriately by a value stream map. The Value stream map is a visual representation of the production flow path showing the movement of materials, information and workmen starting from the supply point and ending in delivery at the customer point.

The Value stream analysis gives an actual representation of the current state, carry out a critique of this initial representation by looking at the value added and non value added path of the flow. A future state is then created showing a visual representation of how value should flow. The feasibility of this new state is then looked at and all forms of process waste eliminated. The new optimised and efficient process is then tested and implemented to fit the prevailing situation with a new 'Ideal State Map' created to show what the improvement should be under a better condition. A Just-In-Time process is then enforced with a single piece flow through customer pull process.

2.5.2 Just-In-Time

Just-In-Time (JIT) is a value stream philosophy that eliminates process waste by process time optimisation. JIT is a value stream philosophy with the primary goal of continuously reducing and ultimately eliminating the major forms of waste due to work-in-process inventory and unnecessary delays in flow time (Brown and Mitchell, 1991; Ohno, 1988; Sugimori et al., 1977b). The primary elements of JIT include having only the required inventory when needed, to improve quality to zero defects, to reduce lead time by reducing setup times, queue lengths and lot sizes, to incrementally revise the operations themselves, and to accomplish these things at a minimum cost (APICS, 1992). It is just having the right part at precisely the right time, and in the right quantity, to go into assembly (Ohno, 1982).

Schonberger (1982a) opined that operating at JIT is simply to "produce and deliver finished goods just-in-time to be sold, sub assemblies just-in-time to be assembled into finished goods, fabricated parts just-in-time to go into the sub assemblies and purchased materials just-in-time to be transformed into fabricated parts". According to Voss and Robinson (1987), "JIT provides for the cost-effective production and delivery of only the necessary quality parts, in the right quantity, at the right time and place, while using a minimum of facilities, equipment, materials and human resources". They further opined that JIT is dependent on the balance between the stability of the users' scheduled requirements and the suppliers' manufacturing or systems flexibility. JIT is accomplished through the application of specific techniques, methods and tools (see Table 3) which require total employee involvement.

Methods and Tools	Definition	References
5S	Defined as the five dimension of workplace organization. Five Ss stands for Sort (identifying unnecessary items), Set in order (orderly organization), Shine (Clean), Standardize (establish the ideal and set guidelines for the standard) and Sustain (maintain standard).	Dale, 1994; Kumar et al, 2006; Womack and Jones, 1996; Worley, 2004; Worley and Doolen, 2006.
Heijunka	Japanese word for 'load smoothing'. A method used to smooth the process due to fluctuation in customer demand.	Emiliani and Stec, 2005.
Kaizen	Japanese word for 'improvement', 'change for the better'. It is a continuous improvement process in small steps. It involves programs for improving quality, cost and lead time in a system through the collective effort of all staff in identifying and eliminating waste in the value stream and within the processes.	Emiliani and Stec, 2005; Krajewski and Ritzman, 2003; Schonberger, 1982a; Shingo, 1981; Womack et al., 1990.
Kanban	Japanese term for sign. It is a system that uses a card to signal a need to produce or transport a container of raw materials or partially finished products to the next stage in the manufacturing process. It is a control system of visual signal that gives authorization and instruction for production or withdrawal of item in a pull system.	Ahmad et al., 2003; Krajewski and Ritzman, 2003; Nicholas, 1998; Schonberger, 1982a; Shingo, 1981; Suzaki, 1987.
Poka-yoke	Mistake proofing techniques that seek to eliminate judgement and discretion thus ensuring control and preventing errors in job performance.	Schonberger, 1998; Shingo, 1981; Suzaki, 1987.
Pull system	The manufacture of a product only when a customer places an order.	Ahmad et al., 2003; Ahmad et al., 2004; Callen et al., 2000; Cua, et al., 2001; Fernando and Luis, 2002; Fullerton and McWatters, 2001; Fullerton et al., 2003; Worley and Doolen, 2006.

Quick changeovers	Method for minimizing the amount of time for changing a machine's setting or to prepare an area to begin processing a new product.	Worley, 2004.
Single piece flow	Where products proceed, one complete product at a time through various operations in the system from design, order taking and production without interruption, backflows or scrap.	Bhasin and Burcher, 2006.
SMED	Single minute exchange of dies is the process flow improvement technique used in the reduction lead-time and change-over delays on machines.	Bhasin and Burcher, 2006.
Standard operating procedures (SOPs).	Detailed descriptions of production tasks which are documented to aid in repeat performance, learning and training.	Krajewski and Ritzman, 2003; Shingo, 1981; Suzaki, 1987.
Takt time	The rate customer demand used to establish link between demand and production activities.	Emiliani and Stec, 2005.
Value stream map	Visual representation of human, material, and information flows within the process. Used to identify areas for waste elimination and possible improvement opportunities in the value stream.	Emiliani and Stec, 2005; Rother and Shook, 2009
Visual control	Signs and other forms of visual information used to simplify activities identification, state or abnormalities recognition and control in the workplace. Lean as a philosophy thrives through visual control.	Emiliani and Stec, 2005; Parry and Turner, 2006.

Table 3. Lean process improvement methods and Tools

All these methods and tools (see Table 3) are to ensure a just-in-time process that is efficient, saves cost, saves time and reduces all form of waste in the system. Lean philosophical quest for perfection ensures a constant continuous improvement mechanism that sees the system continuously being improved.

2.5.3 Continuous Improvement

Continuous improvement is defined as a systematic effort to seek out and apply new ways of doing work and actively and repeatedly making improvements (Anand et al., 2009). Lean is a continuous improvement process. The quest for perfection in the lean philosophy is endless as process improvement methods, mechanisms and tools such as those listed in Table 3 are used continuously to improve the system.

According to Mohanty, Yadav and Jain (2006), standardisation, learning, socialisation and path simplification are the essential building blocks for improvement and provide a specific base to carry out continuous improvement. Continual reiterations of these principles create an intensely structured system for continuous improvement (Mohanty et al., 2006). At Toyota the birth place of the modern day 'Lean philosophy' it is a norm that any operating system can be improved if enough people at every level are looking and experimenting closely to improve their own work system (Mohanty et al., 2006).

Improvement can be categorised as either small incremental change called Kaizen or innovative step change termed process re-engineering (Bond, 1999). Although the two are complementary, the continuous improvement process in Lean philosophy is usually from 'Kaizen' small incremental change by operatives on the shop floor who identify problems and spontaneously propose solutions from experience. An approach that helps organisations in their continuous improvement effort is Deming's (1982) "Plan-Do-Check-Action (PDCA) virtuous cycle of improvement".

- **P**lan – study current situation from trend in existing data, identify problem and plan improvement.
- **D**o – deploy the pilot measures on a trial basis.

- **C**heck – observe, examine and analyse the effect of the changes to see if the desired result was achieved.
- **A**ction – deploy the successful measure on a permanent basis and standardise it in the organisation.

The final action from the PCDA virtuous cycle of improvement is to correct the cause not the symptoms in order to eradicate a problem permanently and so effect permanent improvement (Bond, 1999).

Lean as a philosophy aims for perfection and this makes the improvement cycle in Lean a continuous one. There is this continual strive for perfection in Lean that makes it continuous system for process improvement. Sustenance is essential in Lean if the continuous improvement effort is to continue. The organisation must invest time and effort to support the change not just in the process but in the way things are done (Melton, 2005). The outcome from the changes effected should be observed and the improvement from these changes should be measurable. This would provide a benchmark for subsequent continuous improvement effort.

2.6 OUTCOME

The outcome of every Lean implementation event has played major role in the wide spread of the Lean philosophy. Every organisation wants to be part of the success story and records and figures tells it all from Toyota to Wal-Mart, Production to Supply Chain, from Services to Management, from Banks to Hospitals these stories has continue to move other organisation to be better by continuously improving their process through the elimination of all forms of waste. For any lean implementation activity to succeed and be sustained its

outcome must satisfy the customer and the people within the system must see Lean as a continuous way of doing things better. It should be a culture.

According to Cochrane (2007), Lean is what an organisation should become by effective system decision and implementation. The organisation becomes structurally flexible (Kinnie et al., 1996) as its resources can be fully optimised to satisfy its customers and other stakeholders. A satisfying outcome sustains Lean. Satisfaction for the customer, the people and all other stakeholders encourages continuous improvement which directly sustains Lean as a philosophy in any system. The customer specifies the value (Rother and Shook, 2009; Womack and Jones, 2003), so the outcome to be met must first satisfy the customer who is the deciding factor in the success or failure of any business. Lean is customer centred. The customer pulls the product that actually starts the whole process in a lean environment.

Lean is judged by what it does. Lean outcome include customers and employee satisfaction, improved market share and bottom line results (Upadhye et al., 2010a). So it is very important to work backwards from your customers to see them, to know what they want, to know what they fill in terms of what you offer them, to know the real outcome of your product or service. Are you doing a better Job of meeting the customer's exact need with less resource? So the question of real satisfaction comes in. Less resource is not heard count reduction or laying off workers, it is head growth. If the organisation is serving its' customers with less resources that means it can solve more problems. So the question is about output, 'are we satisfying our customers with our quality of service and product'?

2.6.1 Quality

Quality is the degree to which a good or service meets the need or requirement of its customers or users, it is a level of reliability (Deming, 1981; Juran and Gryna, 1988). It is fitness for purpose (Juran and Gryna, 1988; Harvey and Green, 1993) and conformance to requirement (Crosby, 1979). It is the wise choice that guarantees value to both customer and business owners. According to ISO 9000:2000, quality is defined as "the degree to which a set of inherent characteristics fulfils requirements". Requirements may be stated or implied. These requirements that are needed to be fulfilled from this definition are related to the specific product or service.

Lean production system is that optimisation system synonymous with quality. Lean production system has been globally acclaimed as one those right choices of quality that never happens by chance but as a process it is continuously driven by intelligent soft systems mainly the human resource of the organisation. Lean is the dynamic, knowledge driven, customer focused process through which all people in a defined enterprise continuously eliminate waste with the goal of creating value through quality.

Quality undoubtedly stands out as an outcome of Lean philosophy as service are rendered and products are produced right the first time or not at all (Liker, 2004). Ensuring that the right quality comes out as the output is essential as this reduces and possibly eliminated the waste due to defects. It also eliminates goods returns inwards due to defects observed by customers thereby ensuring that customers expectations are met in terms of service and product standards. Effective implementation of the Lean philosophy results in improved output and quality levels which are achieved using fewer resources, such as raw materials and employee effort (Boyle and Scherrer-Rathje, 2009).

2.6.2 Efficiency and Effectiveness

Efficiency means producing results with little or no wasted effort. It is the ability to carry out actions quickly. Efficiency is based on the idea of reduced wastage. Lean is a construct that originated from a continuous quest for efficiency. Lean is as old as the quest for efficiency. Efficiency in agriculture for more food, efficiency in the battle fields of Wars, Efficiency in manufacturing, in production, in anything that needs efforts, inputs in resources whether human or material. This is all about being Lean.

Effectiveness means producing results that meets the need, satisfies the customer and meets the organisation's objectives on output, profit and customer satisfaction. An effective system always takes time to stop, evaluate and re-evaluate rather than running faster and faster. This ensures that the real and actual needs are met rather than the perceived needs.

Efficiency refers to speed or quantity in relationship to time spent while effectiveness refers to quality or quantity that meets the need, which satisfies. Lean is a continually improving cycle of effective and efficient optimisation of available resources which is dependent on the human resource and its knowledge, skill and ability to optimise the use of other resources. Philosophically, lean implementation ensures systems efficiency and effectiveness and these are essential outcome of lean deployment which breeds internal satisfaction for process owners and external satisfaction for customers.

2.6.3 Satisfaction

Satisfaction can be viewed as an outcome of an experience or a consumption activity (Parker and Mathews, 2001). In Lean it should be viewed from two perspectives of the customers' experience and from the people (internal and external stakeholders) experience.

2.6.3.1 Customer satisfaction

Customer's satisfaction is based on the outcome from the experience with the product or service rendered. It is focused on the nature of the satisfaction which could be based on Emotion, Fulfilment and State (Oliver, 1989; Parker and Mathews, 2001; Rust and Oliver, 1994).

- Emotion: From this perspective, satisfaction is viewed by some as the surprise element of product acquisition and/or consumption experience (Oliver, 1981), while others view it as an effective response to a specific consumption experience (Westbrook and Reilly, 1983).
- Fulfilment: Here satisfaction is driven by the desire to meet needs as behaviours are directed at the achievement of relevant goals which are the motivating factors. So, from the fulfilment perspective, satisfaction can be viewed as the end-point in the motivational process (Parker and Mathews, 2001). "The consumer satisfaction is the consumer's fulfilment response" (Rust and Oliver, 1994).
- State: This framework of four satisfaction state relates customer satisfaction to reinforcement and arousal raging from low arousal which means 'just contentment' to high arousal which is termed satisfaction as surprise "positive – delight" or "negative –shock" (Rust and Oliver, 1994).

The customer's voice here is essential as only the customer can determine value as he ultimately pays for the value created and so keeps the business going. If the customer is not satisfied the long term existence of the organisation is in doubt, so the organisation must strive to satisfy its customer. The Lean philosophy is customer driven and its success story is from the voice of the customer. Lean is a pull system. It is pulled by the customer. He

determines the quantity and quality to be produce because he pays for it. So must be satisfied. Customer satisfaction is seen as a main success factor in the sustenance of Lean when implemented. This means that greater attention is placed on customer value and satisfaction.

Regular evaluation of the customers feeling as expressed in their opinion and the frequency of their repeat purchase is carried out to gain insight into areas that need improvement and generate ideas to ensure service and product satisfaction which is central to the Lean philosophy.

2.6.3.2 People Satisfaction

The other key party that should be satisfied by the processes, actions and activities in the implementation of Lean are the people. The people include the suppliers who should be seen as partners and are satisfied with their relationship with the organisation and the employees who should derive some level of job satisfaction from lean implementation. Cranny, Smith and Stone (1992) and later Weiss (2002) suggested that job satisfaction should be seen as "an affective (emotional) reaction to one's job, resulting from the incumbent's comparison of actual outcome with those that are desired (expected, deserved). Earlier, Locke (1976) had defined job satisfaction as the "pleasurable or positive emotional state resulting from an appraisal of one's job or job experiences". Whatever the feeling or personal definition, the bottom line is that job satisfaction is a motivational factor in lean philosophy and an outcome from the implementation.

The suppliers who are partners to the organisation, the employees (workforce), the major stakeholders and the management should see the benefit, appreciate it and be committed in its long term sustenance. The entire organisation must derive satisfaction from the

performance of the system after lean deployment which should show visible signs of being safer, better and faster, all at a competitively lower cost.

2.6.4 Feedback

In lean the feedback process is essential as it is a pointer that can tell how the customer feels about the product or the service rendered. Customers feeling as expressed in their opinion on service rendered or goods purchased are taken very seriously in Lean practice as it helps to decipher areas for improvement. The frequency of customers repeat call in or purchase are also a feedback on how they perceive the service rendered or product purchased and this information can be used to gain insight into areas that need improvement and generate ideas that guarantee sales and ensure service and product satisfaction for the customer which is central to the Lean philosophy.

In the practice of the Lean philosophy, shop floor workers constantly receive feedback from the process itself through visual control systems. As they carry out work activities, they receive direct and clear information concerning performance effectiveness (de Treville and Antonakis, 2006). Process information is also widely disseminated to workers (MacDuffie, 1997). Generally, Lean allows for a flow-based layout which makes it easier for a downstream worker to communicate demand and defect information upstream which helps for continuous improvement (de Treville and Antonakis, 2006).

2.7 SUMMARY

This chapter presents a comprehensive literature review of Lean from the historical perspective. It observes a distinct convergence of opinion from most researchers and lean practitioners in the literature. This convergence of opinion on Lean and its deployment are on the elements of Leadership, People, Process and Outcome which are seen as the drivers for lean implementation and sustenance.

A critical look was taken at these four major themes of Leadership, People, Process and Outcome with literature reviewed on what existing researchers had termed as their elements. The elements further reviewed are Vision and Commitment, Long term philosophy, Respect for people, Effective communication, Empowerment, Culture, Value stream analysis, Just-In-Time (JIT), Continuous improvement, Quality, Efficiency and Effectiveness, Customer satisfaction and Feedback.

CHAPTER 3: QUESTIONS ARISING FROM THE LITERATURE REVIEW

3.1 INTRODUCTION

The earlier literature review on Lean gave historical insights and general perspectives on the philosophy. It also showed an observed distinct convergence of opinion from most researchers and lean practitioners on what 'Lean' actually is and what the constituent elements are. This convergence of opinion on Lean and its deployment are on the elements of Leadership, People, Process and Outcome which are seen as the drivers for lean implementation and sustenance.

3.2 QUESTIONS

The Literature review showed agreement on Leadership vision and commitment as a major deciding factor on deployment and sustenance but the questions arising from this proven and well documented opinion (Holweg, 2007; Krafcik, 1988; Liker, 2004; Ohno, 1988; Ohno and Kumagai, 1980; Sugimori et al., 1977a, b; Womack et al., 1990) are

1. Does the commitment shown by the leadership have any relationship with the outcome in lean implementation?
2. Does the commitment shown by the leadership have any relationship with the level of staff motivation in the organisation?

Again, Womack, Jones and Roos (1990), Mann (2005) and Liker (2004 and 2008) expressed the importance of organizational culture to a successful lean implementation and further sustenance but the question is

1. Is there a relationship between the 'people culture' within the organisation and the level of motivation for better performance and how does this relate to the eventual outcome from lean implementation?

The quality of the human resources available in the organisation in terms of competence was also a point of convergence in the literature reviewed (Liker, 2004 and 2008; Shah and Ward, 2003) that sees the ability, knowledge, skills and experience of the available human resources as having effect on the success or failure in the deployment of the Lean philosophy. The questions being asked on the importance of the Human resources as expressed in the literature review are;

1. Is there a relationship between the 'people ability and competence (quality of human resource)' and the level of outcome?
2. Is there a relationship between staff motivation on a lean organisation and what they are capable of doing in terms of ability and competence?

Boyer (1996) defines empowerment in lean philosophical practice as giving workers more responsibility and control of the value stream process, as well as increased level of training to build the skills needed to effectively exercise increased responsibility. Most literature reviewed (Blanchard et al., 2001; Boyer, 1996; Liker, 2004 and 2008; Womack et al., 1990) all assert in concurrence that the empowerment encourages learning experience, builds confidence allow for shop floor level faster continuous improvement process and create an all encompassing process excellence in the organisation. However, de Treville and Antonakis (2006) put the question "could the Lean philosophy as practiced be intrinsically motivating?" So, the questions this research would further ask from these empowerment and motivation assertions are;

1. Is there a relationship between workers empowerment and process excellence as asserted by lean researchers and practitioners?
2. Is there a relationship between staff motivation and the organisation's level of empowerment?

These are the questions that a survey within this action research on lean implementation using soft systems methodology in triangulation would answer to a great extent.

The questions are on leadership, organisational culture, ability and competence of the people (the human resource), empowerment, motivation, process excellence, and the outcome. These are the main groupings from the questions which are further broken down into its constituent elements from literature reviewed and field observations. The combined questions from all listed aspects were built into a questionnaire and administered to respondents in organisations practicing lean using the five likert scale system in responding 1 for 'strongly disagree', 2 'disagree', 3 'neutral', 4 'agree' and 5 for 'strongly agree'.

3.2.1 Leadership questions

The leadership question section of the questionnaire had eight questions. Question i, "Management develop and communicate clear organisation's vision to all" is same as question LI3 from the questionnaire used in Peng, Schroeder and Shah (2008). Question iii "There are long term plans for achieving these goals" is also related to question ST1 used in Peng et al. (2008). Question vii and viii (see Appendix 1 "Research Questionnaire") are reflections from the questions used in Terziovski and Samson (1999), Bou-Llusar, Escrig-Tena, Roca-Puig and Beltran-Martin (2009) and the proposition on work facilitation and the lean philosophy by de Treville and Antonakis (2006).

3.2.2 Organisational Culture questions

People working in teams or in groups are one of the cultural practises in Lean. Cross functional teams are formed to solve problems (Boyer, 1996). Question i in the Organisational Culture question section of the questionnaire “People work in Team” seek to ascertain the extent to which teamwork is encouraged within the system and it is the same as the question used in 3c5 in Bou-Llusar et al. (2009).

3.2.3 Empowerment questions

Boyer (1996) asserted that training and development as an essential infrastructural investment in Lean. In the research questionnaire used for the survey (see Appendix 1) question ii of 7 “Workers are fully involved in problem solving” and v of 7 “Workers are involved in cross training” are related to the questions used in Shah and Ward (2007). Question vii of 7 and ix of 7 are the same as the questions used in 3c3 and 3d3 in Bou-Llusar et al. (2009).

3.2.4 Ability and Competence questions

In the questionnaire used for the survey, questions i of 8 “People needed for each Job are planned, managed and improved”, ii of 8 “Emphasis is placed on recruiting highly skilled employees”, iii of 8 “People’s knowledge and competences are identified, developed and sustained”, vii of 8 “Specific training is needed for the job” and viii of 8 “Extensive training means are provided for staff” are related to the questions used in 3a and 3b in Bou-Llusar et al. (2009).

3.2.5 Motivation questions

According to Pinder (1984) and de Treville and Antonakis (2006), “work motivation is a set of energetic forces that originate both within as well as beyond an individual’s being, to initiate work-related behaviour, and to determine its form, direction, intensity, and duration”. De Treville and Antonakis (2006) further suggested that a configuration of lean philosophical practices is very important for workers motivation. Among these practices is the job design, the job environment, job compensation, job security and the level of autonomy allowed. The questions on motivation based on literature and observations are set out to establish the level of the organisation concurrence researchers’ assertion on workers motivation in a Lean environment (De Treville and Antonakis, 2006; Liker, 2004 and 2008; Shah and Ward, 2003 and 2007; Womack et al., 1990).

In the survey questionnaire, question vi of 9 (Motivation) “Workers are recognized and rewarded for suggestions and achievement” is related to expression used in question 3e in Bou-Llusar et al. (2009).

3.2.6 Process Excellence questions

Questions on process excellence looks at the tell tale signs of continuous improvement actions, activities and processes within the lean practicing organisation.

In the survey questionnaire questions

- ix of 10 “Efforts are made to reduce set-up time”,
- x of 10 “Production/ Service delivered is ‘pulled’ by demand”,
- xi of 10 “Production/ Service delivered is ‘pulled’ by delivery of finished goods/ services”,

- xiii of 10 “Process capability studies are constantly conducted”,
- xx of 10 “Suppliers respond on time”,
- xxiv of 10 “We communicate constantly with our suppliers”,
- xxv of 10 “We have strong and long term relationship with suppliers” and
- xxvi of 10 “We give our supplier’s feedback on quality and delivery performance” ,

are to a great extent same as the questions used in Setup_01, Pull_02, Pull_01, SPC_05, SuppJIT_02, Suppfeed_01, Suppfeed_05 and Suppfeed_04 in Shah and Ward (2007).

3.2.7 Questions on Outcome and feedback from lean implementation

The question in this section of the survey questionnaire expresses the fact that what is achieved tend to encourage further implementation and general sustenance of the philosophy within any system. Questions

- i of 11 “We communicate constantly with our customers”,
- ii of 11 “Our customers give us feedback on quality and delivery performance”,
- iii of 11 “Our customers frequently share current and future demand information with us”,
- vi of 11 “We regularly conduct customer satisfaction surveys”,
- vii of 11 “There is extensive use of statistical technique to reduce process variance” and
- viii of 11 “Charts showing defects rates are constantly being used”,

are to a great extent same as the questions used in Custinv_01, Custinv_03, Custinv_06, SPC_01, SPC_02 and SPC_03 in Shah and Ward (2007).

3.3 SUMMARY

This chapter presents questions originating from the literature reviewed. The resulting questions bothers on leadership, organisational culture, ability and competence of the people (the human resource quality), empowerment, motivation, process excellence, and the outcome. The questions sourced to satisfy the inquest into these groupings are the questions that formed the major part of the questionnaire (see Appendix 1) that was administered as part of a field survey within the action research on lean implementation using soft systems methodology in triangulation would be answered in subsequent chapter.

CHAPTER 4: THE LEAN IMPLEMENTATION MODEL

4.1 INTRODUCTION

Existing open evidence of successful implementation of lean in top companies worldwide has shown that it resulted in a more efficient system with improved business processes and better financial performance. Lean as a philosophical process improvement method should ideally follow a step by step implementation guide or model to ensure success. Various models such as the "model of commitment to lean production (Boyer, 1996)", Lean operational model (Karlsson and Ahlstrom, 1996), Lean production model (Sanchez and Perez, 2001) and the extended model of design process of Lean (Houshmand & Jamshidnezhad, 2006) has been used and discussed in the past. This study takes a critical look at these models and other closely related models with a view of identifying existing gaps and developing an improved model that will bridge the identified gap and serve as a cross industrial model for the implementation of Lean.

4.2 LITRATURE REVIEW ON EARLIER MODELS

Upadhye, Deshmukh and Garg (2010) proposed model for lean implementation (see Figure 3) looked at the situations in an organisation and expressed them as needs in their model. These needs includes; uncertainty, complexities, global competitive market, demand fluctuations, innovations and high variety (Upadhye et al., 2010). The issues which resulted in these needs, has expectations which is customers and employees' satisfaction. To match these issues (lead time reduction, workers participation, customer satisfaction, machine breakdown, inventory and quality management) with the expectations, a lean manufacturing system with tools such as value stream mapping, 5S, Kaizen, single piece flow

and Pokayoke are used to produce results of better quality, in lesser time, fewer space and happier people.

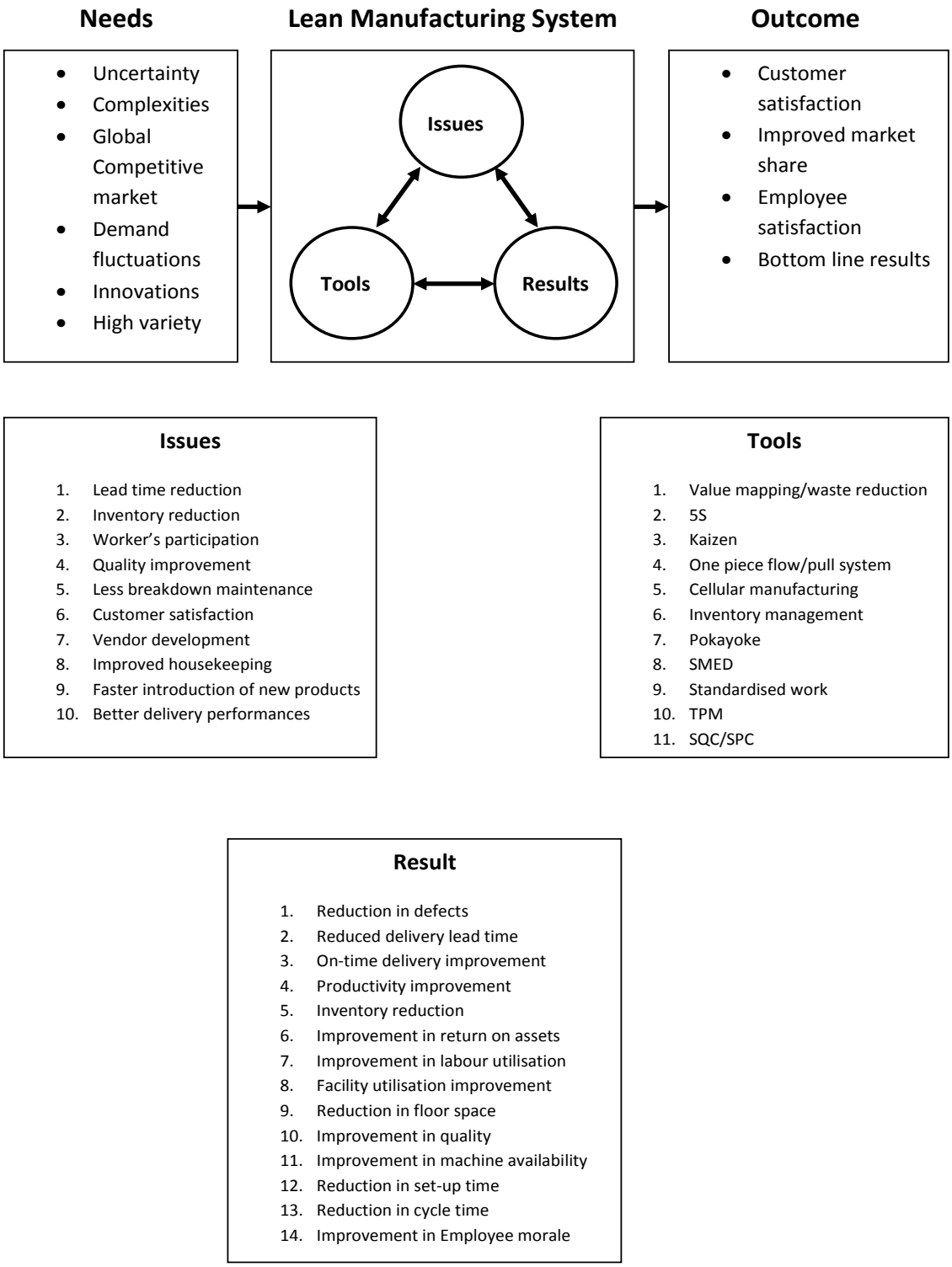

Figure 3. "Proposed model for LMS (lean manufacturing system) implementation". Source: Upadhye et al. (2010)

In Upadhye, Deshmukh and Garg (2010) proposed model for lean manufacturing system implementation (model of issues, tools and results) nothing is said about the key enablers of leadership commitment and competently empowered people. Boyer (1996) examined the relationship between a company's commitment to lean production and the actions taken by management to develop the skills and knowledge of the workforce through training. The conclusion from his case study showed that management commitment with supporting manufacturing infrastructure influences the successful implementation of Lean. In his research, Boyer (1996) focused on what was termed four key infrastructural investments on Training (TRAIN), Worker Empowerment (WEMP), Group Problem Solving (GROUP) and Quality Leadership (QLEAD) (see Figure 4).

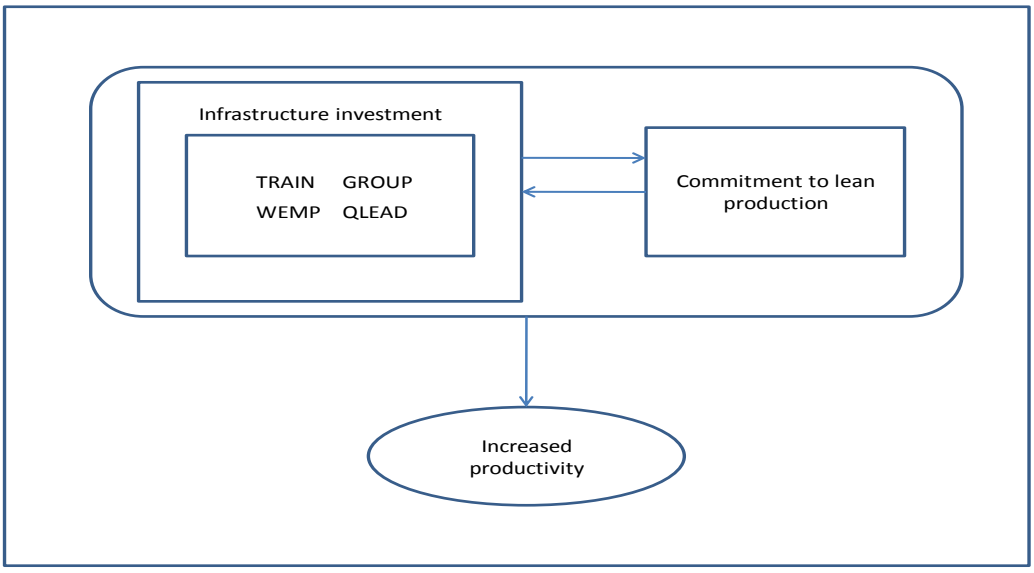

Figure 4. "Model of Commitment to lean production". Source: Boyer (1996)

Boyer (1996) research showed that emphasis and clear management support on these infrastructural investments is a critical component that guarantees the successful implementation of Lean. A continuous improvement infrastructure framework balances an

organisations vision and direction with its quest for innovation and improvement. Investment on training enhances the competency level of employees; it also empowers them to confidently do their job. Boyer (1996) also advocates workers empowerment, given them the authority to take job specific decisions where necessary. The model also encourages teamwork as it allows for group brainstorming and problem solving. Quality leadership and commitment is also a key pillar on which the successful implementation of lean is built on (Boyer, 1996). This leadership directs a culture of continuous improvement that engineers participating structures, processes and people to innovative heights. Karlsson and Ahlstrom (1996) developed a general operational model which assesses the changes taking place at each section (development, procurement, manufacturing and distribution) in the implementation of Lean. Karlssons and Ahlstrom (1996) model shows the need good information flow, supplier's involvement in production planning, the elimination of the eight wastes and the use of multifunctional teams. This use of multifunctional teams was further stressed in Sanchez and Perez (2001) model (see Figure 5).

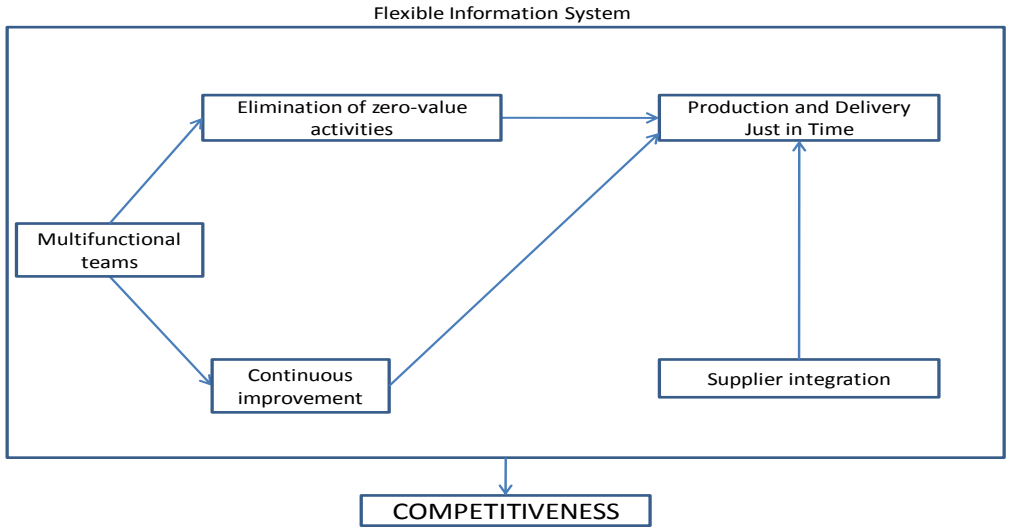

Figure 5. "A lean production model". Source: Sanchez & Perez (2001)

According to Sanchez and Perez (2001), these multifunctional teams are to lead in the continuous improvement effort after all non-value adding activities have been eliminated with the production and delivery of products carried out just in time (Sanchez & Perez, 2001). Soriano and Forrester (2002) worked on assessing whether the lean philosophy is applicable in any industry and to what extent. Their findings confirmed that lean can be practiced in any industry and to any extent deemed optimal. Soriano and Forrester (2002) research also established the fact that "lean comes with change and that there is a strong relationship between leadership commitment to JIT/TQM and investments in the supporting infrastructure". Soriano and Forrester (2002) research findings further confirm Boyer (1996) model and finding that "there is a positive relationship between investment in supporting infrastructure and actual changes towards lean principles and performance". Pedersen and Huniche (2011) model on factors affecting lean projects focused on the factors which shape the interactional processes that take place during the course of lean project. The four influential factors of 'goals and value', 'complexity and importance', 'balance of power' and 'resources and capabilities' were discovered to the key to successful implementation and sustenance (Pedersen and Huniche, 2011).

Houshmand and Jamshidnezhad (2006) created an extended model of lean production. The model was intended to serve as a map that clarifies the process of lean implementation and the required tools and techniques. Unlike the models from Boyer (1996) (see Figure 4), Sanchez and Perez (2001) (see Figure 5) and Pedersen and Huniche (2011) which give key parameters for success but look rather simplistic for implementation, the model is in a complex form with various levels and stages of implementation (from methodologies (PVs),

to principles (DPs), concepts (FRs) and ultimately meeting the customers' needs (CNs)) embedded in it.

Although all the models described differ in origin, some do share some similarities at varying degree and also agree on key factors for success such **LEADERSHIP** commitment (Achanga et al., 2006; Boyer, 1996; Soriano-Meier and Forrester, 2002), trained and competent **PEOPLE** as workforce (Anand et al., 2009; de Treville and Antonakis, 2006; Houshmand and Jamshidnezhad, 2006; Karlsson and Ahlstrom, 1996; Pedersen and Huniche, 2011; Sanchez and Perez, 2001; Shah and Ward, 2003; Shah and Ward, 2007; Soriano-Meier and Forrester, 2002), coordinated and efficient **PROCESSES** (Anand et al., 2009; Karlsson and Ahlstron, 1996; Rother and Shook, 2009; Upadhye et al., 2010; Womack and Jones, 1996; Womack and Jones 2003), all leading to the **OUTCOME** desired by both the customers and the other stakeholders in the organization (Cochrane, 2007; Kinnie et al., 1996; Pedersen and Huniche, 2011; Upadhye et al., 2010). These are the key success factors in the establishment of the lean philosophy in any organisation (see Table 2 from literature review). These four important factor formed the base of the Lean 'Leadership, People, Process and Outcome' (LPPO) implementation model (see Figure 6).

4.3 LEAN LEADERSHIP, PEOPLE, PROCESS AND OUTCOME (LPPO) IMPLEMENTATION MODEL

The 'Leadership, People, Process and Outcome' (LPPO) model (see Figure 6) for Lean implementation builds from the strength of existing models (Boyer, 1996; Houshmand & Jamshidnezhad, 2006; Karlsson & Ahlstrom, 1996; Pedersen and Huniche, 2011; Sanchez & Perez, 2001; Upadhye et al., 2010) to establish a simple but complete implementation model which directs (showing sequences of intervention) and drives the process and also

guarantees success in the implementation of Lean. The LPPO model shows commitment and vision from leadership as the key driver of a competent and empowered people that efficiently optimizes the performance in the business processes to achieve highly competitive products and services as outcome. The principles and strength (Leadership, People, Process and Outcome) which form the mantra of the model was further strengthened from observation at two UK based companies visited at the model design completion stage. The processes and performance of these two organizations (A Healthcare and Beauty Product manufacturing company and an Aluminium Conservatory production company) showed that the Leadership, People, Process and Outcome of the lean implementation were major implementation and sustenance factors after the deployment of the Lean philosophy.

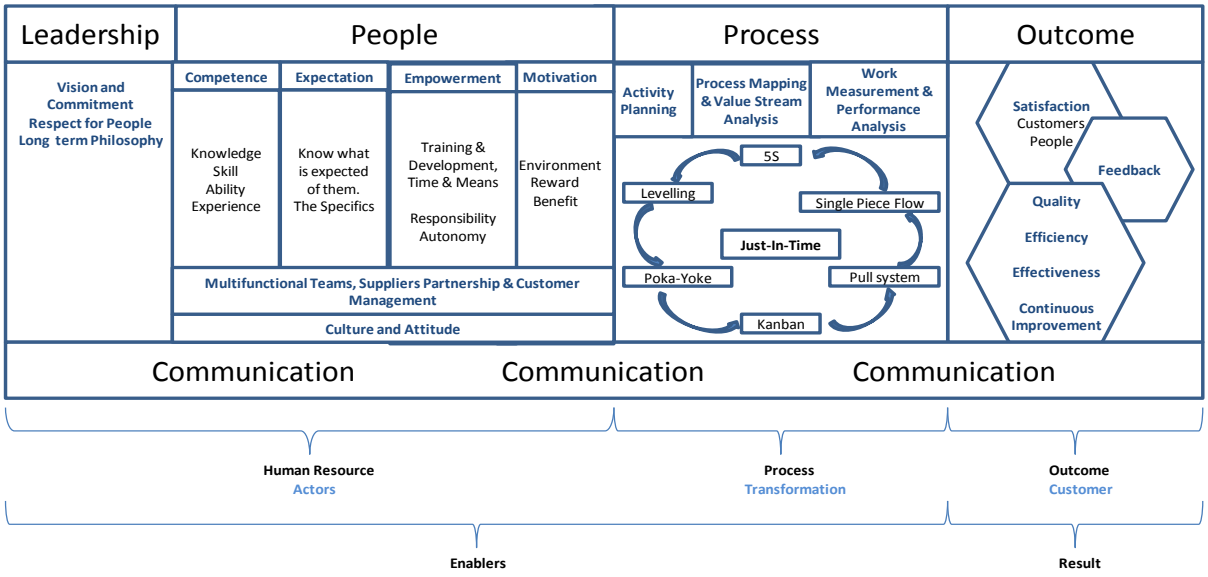

Figure 6. Lean Leadership People Process Outcome (LPPO) Implementation Model

4.4 SUMMARY

This Chapter reviews existing Lean models from literature and develops 'the Lean Leadership, People, Process and Outcome (LPPO) implementation model'. The design of the model was further strengthen by the observations at two UK based firms (A Healthcare and Beauty Product manufacturing company and an Aluminium Conservatory production company) that had successfully implemented lean and had sustained it for more than four years respectively. The model developed is a cross industrial framework for the implementation of lean that shows sequences of intervention with innate direction for the deployment of Lean. The philosophical mantra of the model (LEADERSHIP, PEOPLE, PROCESS and OUTCOME) was tested and validated by findings in a real scenario (case study) during the action research using the soft systems methodology in triangulation. The action research and the findings from the various cases from different organisations are reported in subsequent chapters.

CHAPTER 5: RESEARCH METHODOLOGY

5.1 INTRODUCTION

Lean was Ohno's (1988) improvement to Ford's mass production which thrived on large scale production and economies of scale (Ford et al., 1988). It was ohno's efficiency response to the twin flaws of large batch sizes which resulted in excess inventory and none diversity in products which existed in Western production system based on mass production which existed in the early twentieth century (Holweg, 2007). The challenges that resulted in the disruption of production and sales during the Second World War also contributed to ohno's lean optimisation philosophy based on his concept of small lot size production throughout his Toyota manufacturing company. The focus was to reduce cost by eliminating all forms of waste due to Defects, Overproduction, Unnecessary Inventory, Over Processing, Transportation, Excessive Motion and Waiting (Ohno, 1988). All these was aimed at meeting Toyota's organisational needs at that time but this ingenuity created the Toyota production system whose tact in efficiency, resource management, continuous improvement and consistent positive business results revolutionized process optimization for customer satisfaction and business success.

There have always been organisational needs necessary to achieve set goals, but resources to meet these needs are usually scarce. The usual scarcity of resources has consistently lead to organisational research and analysis on how best to optimise available resources to meet the needs and satisfy all stakeholders of the organisation. The lean philosophy is the vogue in today's industrial, services and allied organisation as all seek to optimise the use of its resources in satisfying customers and other stakeholders. Researches and studies on various organisations journey towards lean has been on the increase in the body of knowledge but

their methodological approach have been mostly Normative which seek to establish law like relationship between objects synergy, efficiency and control based on nomothetic science of positivism. Such researches are classified under the functionalist paradigm (Burrell and Morgan, 1979). Most of these studies have been quantitative (Inman and Mehra, 1992; White, 1993; Norris et al., 1994; Callen et al., 2000; Cua et al., 2001; Fullerton and McWatters, 2001; Fullerton et al., 2003; Shah and Ward, 2003; Jayaram et al., 2008; Eroglu and Hofer, 2011) basically quantifying a social technical construct which is what the lean philosophy truly is. Are these approaches actually the best? Are they realistic? Why not qualitatively based research based on social constructionism (Schwandt, 1994, 2000) or Phronesis based on the Aristotelian methodology (Flyvbjerg, 2001) or the Social Technical Soft Systems Methodology (Checkland, 1981) that tends more towards the interpretivist paradigm (Burrell and Morgan, 1979)?

5.2 RESEARCH METHODS REVIEW

Burrell and Morgan (1979) has distinctively streamlined the various organisational research and analysis carried out in hundreds of ways and patterns into four paradigms. They are the functionalist, the interpretive, the radical humanist and the radical structuralist paradigms. The functionalist sees reality as one and believes that by dividing and studying its part, the whole can be understood (Burrell and Morgan, 1979). They are positivist adopting and using scientific knowledge and assumptions for organisational analysis (Hardy and Clegg, 1997). Here human actions are explained and understood by hypothesis testing. The interpretive view the world as a social interactive construct with multiple realities whose synergy and effective interconnectivity leads to the whole. This ‘whole’ can only be understood by understanding the ‘multiple realities’ (Burrell and Morgan, 1979). Organisational behaviours

in the interpretive paradigm are explained by better understanding the individual behaviour. The radical humanist view of the society emphasises the importance of beating the limitations of existing social arrangement (Burrell and Morgan, 1979). Just like the interpretive paradigm, it views the social world from a nominalist, anti-positivist, voluntarist and ideographic perspective (Burrell and Morgan, 1979). It is subjective and it is viewed as the extreme of the interpretive paradigm. The radical structuralist takes an objective science based change approach. It is an extreme form of the functionalist paradigm based on the functionalist theory. It is committed to radical change, emancipation and potentiality. It emphasises structural conflict, modes of domination, contradiction and deprivation. It takes a realist, positivist, determinist and nomothetic standpoint (Burrell and Morgan, 1979). A frame work of four research approaches namely normative, interpretive, critical and postmodern were also identified (Alvesson and Deetz, 1996; Hardy and Clegg, 1997). The normative approach seeks to establish social relationship based on nomothetic science just as Burrell and Morgan (1979) functionalist paradigm has established. The interpretive approach of Alvesson and Deetz (1996) and Hardy and Clegg (1997) see the organisation as a social site (Deetz, 1996). Their (Alvesson and Deetz, 1996; Hardy and Clegg, 1997) shares same idealistic tendencies and philosophy as Burrell and Morgan (1979) interpretive paradigm. The critical approach also known as the critical theory seeks to unmask domination using the critique ideology to reform the social order (Alvesson and Deetz, 1996). It reveals the structure of oppression and offers emancipator ideas as it focuses on the incompleteness or flaws within 'the project' (Hardy and Clegg, 1997). The postmodern approach also known as the dialogic approach denies that the entire thing is inherently problematic (Alvesson and Deetz, 1996). The postmodern approach challenges the ideas concerning grand theory, fixity of meaning and the essentialism of the subject, it announces

the death of meaning and modernity which the critical modernist attempt to salvage through critique (Hardy and Clegg, 1997). By deconstructing and reconstructing 'meaning' from history, tradition and the organisation through the use of ironic, ambivalent, playful narratives, the postmodern approach creates space for the lost voices (Alvesson and Deetz, 1996; Hardy and Clegg, 1997). With the already expressed uniqueness of the critical and postmodern approaches it is expedient to focus on the similarities in the Alvesson and Deetz (1996) approach and Burrell and Morgan (1979) sociological paradigms which are the Interpretive paradigm or approach and the functionalist paradigm which has same scientific base as the normative approach.

Burrell and Morgan (1979) sociological paradigms on organisational research and analysis has polarized research into key expressive style insisting that all researcher should take a clear stand on the paradigms. Although some still view the paradigms as just two (Interpretive and Functionalist) with the other two (Radical humanist and Radical structuralist) as respective extremes of the first two, taking a stand from Burrell and Morgan (1979) point of view is to a great extent unnecessarily polarizing (Karatas-Ozkan and Murphy, 2010) as organisational research are social by nature and thus interacts with the relatively unpredictable human factor in its environment.

The basic idea from Burrell and Morgan (1979) paradigm philosophy is expressed in most research approach in the form of either quantitative or qualitative research approach. Which are the basic direct approaches used in studies. These two approaches are distinctly associated with Burrell and Morgan (1979) paradigms. The quantitative approach is a positivist approach which is based mainly on the functionalist theory or paradigm which perceive the world as external and objective. From a scientific perspective they see reality

as one that can be divided into constituent parts and analysed to be able to understand the whole. They deduce causes and effect patterns using scientific analytical principles and structures to predict relationships and pattern of behaviour. The purpose of quantitative research is basically causal or predictive rather than exploratory which is the hallmark of the qualitative research.

The qualitative research approach which is basically exploratory and tends fully towards the interpretive paradigm, view the world as a socio-technical and psychological construct where multiple realities forms an interconnected whole. Qualitative analysts are of the view that the whole can only be understood by understanding the multiple realities. Lean is an integrated socio-technical philosophy with the main objective of eliminating waste by concurrently reducing or minimising supplier, customer, and internal variability (Shah and Ward, 2007). As a social-technical philosophy, lean should be ideally studied, implemented and improved from an exploratory point of view which is qualitative, but most research and studies on lean has been carried out more from the quantitative point view as their analysis are fully quantitative by nature (Inman and Mehra, 1992; White, 1993; Norris et al., 1994; Callen et al., 2000; Cua et al., 2001; Fullerton and McWatters, 2001; Fullerton et al., 2003; Shah and Ward, 2003; Jayaram et al., 2008; Eroglu and Hofer, 2011). This might partly be related to the fact that lean as a philosophy originated from the science of production engineering (Krafcik, 1988; Ohno, 1988; Womack et al., 1990). This notwithstanding, researchers in the organisational sciences and management engineering have traditionally advocated the use of multiple methods of both qualitative and quantitative approach (Campbell and Fiske, 1959). This combined form of research strategy is what has been described as Multi-method, Convergent or Triangulation (Campbell and Fiske, 1959; Jick,

1979; Webb et al., 1966). The use of this strategic combination is based on the conception that qualitative and quantitative methods are complementary rather than opposite and distinct and are most suitable for organisational phenomenon or philosophy of optimization such as Lean which is more system based. As real excellence in Lean implementation which is organisational and thus systems based, can be ascribed to the ingenuity of efficient and effective systems thinking.

5.3 SYSTEMS THINKING

"Systems is an epistemology, a theory of knowledge which we adopt to help us understand the world" (Stowell, 2009). A System is a set of interconnected entities (which include people, processes and technology) that are dynamic in behaviour with a purpose or reason for existence (Siemieniuch and Sinclair, 2006; Singleton, 1974). It is "a set of element connected together which form a whole, thus showing properties which are properties of the whole, rather than properties of its component parts" (Checkland, 1999). These properties of the whole are termed emergent properties (Checkland, 1999). An emergent property is a symbol of the synergy with the properties of the whole being greater than the sum of its constituent parts. This strength of a system is bases of the phenomenon known as system thinking.

"Systems thinking is an intellectual device to help make sense of the world" (Stowell, 2009). Systems thinking was the result of the critique of reductionism that emerged in the twentieth century (Flood, 2010). Reductionism is an approach to building descriptions of systems out of the descriptions of the subsystems that a system is made of, and ignoring the relationships between the subsystems. Reductionism brought about knowledge and understanding of phenomena by splitting them into their constituent parts and then

studying the cause and effect of these simple constituent parts known as elements. However, the Reductionist could not effectively explain the properties that a system exhibits as a whole which its constituent parts or elements do not exhibit. With system thinking the belief is that the world is systemic and so a phenomena can only be understood to be an emergent property of an interrelated whole (Flood, 2010). “Emergence and interrelatedness are the fundamental ideas of systems thinking” (Flood, 2010) as the phenomenon is based on the insistence that systems of all forms and types must be analysed as a whole in order to understand its emergent properties and the interrelatedness of its constituent parts (O’Connor and McDermott, 1997).

Some of the early recorded systems theorists and their methodologies include, Bertalanffy (1969) the General System Theorist, Ackoff (1970 and 1979) the Interactive Planner, Beer (1979 and 1985) the Viable Systems Diagnosis using the Viable System Model, Churchman (1971 and 1979) Critical System Heuristic, Checkland (1981) Soft Systems Methodology and Senge (1990) the Causal Loop Mapping (CLM) practitioner.

Systems thinkers are often characterized by their interest in complexity, often described as an ‘Ackoff mess’ (Checkland, 1981; Barton and Haslett, 2007). Both Hard and Soft Systems thinking are focussed on solving real-world problems, but the difference is in the fact that the goals of Hard systems are known and clearly defined while Soft systems problems are unstructured and there is only the potential of alleviating the problem situation by causing a high level of improvement.

Systems thinking are an essential way of addressing complexity (Stowell, 2007). Systems thinking have metamorphosed from a perspective that sees the world as consisting of real system, to one in which the world is seen and understood as a systemically organised

conception (Flood and Jackson, 1991). Systems thinking involve thinking about system boundaries as well as the systems that the boundary excludes (Stowell, 2007). Systems are no longer regarded as representational tools but as systemic metaphor that appropriately sheds light on situations encountered (Floyd, 2008). This is distinct because rather than seeing systems as things recovered as objective features of the 'world', they are seen as systemic thoughts of conceptual engagement that arises when subjects interacts with the world using particular processes of cognition (Floyd, 2008) as is the case in Soft Systems Methodology.

Checkland (1981) elaborating on his Soft Systems Methodology, argued that 'Human Systems' which are different from other systems should be understood from the meaning people give to the world "Weltanschauung". This is soft systems thinking, a form of systems thinking that sees reality as a construction of people's interpretation of their experiences, thus linking itself to the interpretive theory (Flood, 2010) which is a core part of the Soft Systems Methodology (SSM).

5.4 SOFT SYSTEMS METHODOLOGY

Soft Systems Methodology (SSM) can be described as 'objectively carrying out a case based action research, using Peter Checkland's step by step specification or methodology'. Peter Checkland's Soft Systems Methodology consist of a seven stage inquiry process which starts with an initial appreciation and expression of the situation using one or more rich pictures, followed by the definition of a number of 'human activity systems' thought to be relevant to the situation of concern (Checkland, 1981; Checkland and Scholes, 1999). These human activity systems are given a formal 'root definition' which is a declaration of the purpose of the system. What need to be done next is to select a particular perspective and put it

through a very structured and rigorous model development process developed by Peter Checkland using the mnemonic CATWOE.

- **C**-Customer: Everyone who benefits or lose from the output of the system.
- **A**-Actor: The actors perform the activities defined in the system.
- **T**-Transformation: Process of conversion of inputs to output.
- **W**-Weltanschauung: German expression for world view. This world view makes the transformation process meaningful in context.
- **O**-Owner: Every system has some proprietor, who has the power to start up and shut down the system.
- **E**-Environmental constraints: External elements exist outside the system which it takes as given. These constraints include organisational policies as well as legal and ethical matters.

Clarity gained by addressing these key perspectives separately and understanding their implications is then used in building the conceptual model and comparison is then made between the first rich picture and the conceptual model. The understanding of the possibilities and limitations from this comparison is then used to define a desirable and feasible change model to be adopted as a continuous improvement measure to be taken. This continuous improvement is a core philosophy of Lean.

Soft System Methodology is a very interactive approach to academic research in general and system development and therefore it is highly suitable for this research. Since the whole essence of action research is to contribute to solution of human practical problems in real

world situations the connections between action research and soft system methodology is quite natural (Bjerke, 2008) and so, the method was an obvious choice.

For Peter Checkland the originator of Soft System Methodology, there are no words like SOLUTION or PROBLEMS when working with this methodology. This is due to the fact that PROBLEM suggest that there is a clearly defined problem at hand which is not true for a social-technical system. Also, the word SOLUTION implies that the problem has been fixed forever which is also very wrong when referring to human systems and organisations (Bjerke, 2008).

Every system or methodology has its flaws and the soft system methodology is no exception. Minger (1984), Flood and Jackson (1991), Lane and Oliva (1994) and Jackson (1992, 2003) all argued that because of the interpretive nature of soft system methodology, it cannot be regarded as a problem solving methodology. Lane and Oliva (1994) see soft system methodology as a method used to explore the real world but because its models are not descriptive of the real world which according to the soft system philosophy is difficult to grasp, the models are merely normative.

Although opponents and users alike acknowledge the fact that the use of soft system methodology has been successful in its application to real world complex management situation, they are also aware of its limitations but most importantly, its benefits of interactive and communal involvement in the search and quest for continuous system improvement were it has continuously been successful cannot just be ignored. This overwhelming area of advantage is the main reason for its use in this research as it is flexible and very engaging and so can probe further and dig deeper to search out facts were other methods cannot reach.

The Soft system methodology being used addresses the complexity of all the parameters so far listed which are in essence the management and quality needed for lean. The use of the methodology focuses on relationship management, internal coherence with the organisational purpose and goal in mind, adaptability and transparency which can be seen from the ideological dialogue and mediation based philosophy of the soft systems methodology. Soft systems methodology allows for a mixture of social and technical factors in decision making. It is continuous improvement system which provides for an integrated learning process.

The Soft Systems Methodology which can be described as philosophically aligned to phenomenology (Husserl, 1962) and sociologically aligned to interpretivism (Burrell and Morgan, 1979) and constructivism (Checkland, 1981) is a non reductionist method which recognizes the importance of subjectivity and as such opened to criticism based on its inductive and non-fuctionalist nature. The existence of these criticisms which is purely ideologically based does not give any better credence to the use of reductionist approach which is deficient in confronting organisational issues arising from the complex and intricate nature of social situations involving the relatively unpredictable human resource. What is required therefore is the Triangulation approach which allows for a combination of the strengths of both reductionist and non-reductionist methods, (quantitative and qualitative methods) to create better understanding and engenders a relatively predictable and controllable process which encourage continuous learning and possible optimisation within the organisation's system.

5.5 TRIANGULATION

Triangulation is the combination of various research approaches and the use of different data collection methodologies (Scandura and Williams, 2000) for objective fact finding and analysis in the study of same phenomenon as the convergence of multiple views allow for greater accuracy in objectivity. Etymologically, the triangulation metaphor is from navigation and military strategy where multiple reference points are used to locate an object's exact position (Jick, 1979; Smith, 1975). Early researchers (Denzin, 1978; Smith, 1975; Webb et al., 1966) have strongly advocated for the use of triangulation as they argued that more than one method should be used in the validation process to ensure a full reflection of the exact property or traits of the subject or phenomenon rather than the that of the methodology (Campbell and Fiske, 1959; Jick, 1979). "Thus, the convergence or agreement between the methods, enhances the belief that the results are valid and not a methodological artefact" (Bouchard, 1976; Jick, 1979).

The methodological triangulation carried out in this thesis included the quantitative method of survey in combination with the qualitative methods of participant observation and semi-structured interview all within a soft systems methodological framework based on systems thinking. A framework based on systems thinking is ideal as most scholars have described lean as a complete system (Shah and Ward, 2007; Womack et al, 1990) that welds the activities of everyone from top management to line workers, to suppliers, into a tightly integrated whole that can respond almost instantly to resource fluctuations and marketing demand from consumers. As a system philosophy, lean should be approached from a system view. Checkland (1999) sees a system as 'a set of elements connected together which form a whole, thus showing properties which are properties of the whole, rather than

properties of its component parts". System thinking insists that systems must be analyzed as a whole in order to understand its emergent properties and the interrelatedness of its constituent parts (O'Connor and McDermott, 1997).

Implementing the systems optimisation philosophy of lean in an organisation or investigating the level of optimisation within the process or system that has implemented lean involves analysing the system as a whole rather than believing that by dividing and studying its parts, the whole can be understood from the functionalist paradigm's stand point. Analysing the system as a whole is from the 'interpretive school of thought' as the 'organisational world 'the company'' is a social interactive construct with multiple realities whose synergy and effective interconnectivity leads to the whole. Thus, using the Soft Systems Methodology in Triangulation is seen as ideal for this research. As the methodology adopted is able to effectively and objectively study the processes of lean implementation for systems optimisation in organisations by taking a holistic look at the systems with their process owners in the forefront. The use of Triangulation also effectively cross check the internal consistency or reliability within methods while it test the validity level between methods (Jick, 1979), thus confirming the validity of the process (Stake, 1995).

A Comparison of the Ontology, Epistemology, Methodology and Human Nature of the Soft System Methodology, the use of Questionnaires and the use of the Triangulation (a combination of both Soft Systems Methodology and Questionnaire) is presented in Table 4.

Social Nature	Soft System Methodology	Questionnaire	SSM & Questionnaire
Ontology	Soft Systems are not assumed to exist in the real world. SSM is just a concept or label used to describe a social technical and structural analytic procedure. SSM is based on the nominalistic ontology that believes the social world external to individual cognition is made up of nothing more than names, concepts and labels which are used to structure reality.	Ontologically, the use of questionnaire brings the feel of realism as it gives a concrete and tangible evidence for use and so creates and shows a factual measurable result for a more or less subjective construct.	The use of the Soft System Methodology and Questionnaire makes the fact about the implementation and success of a subjective construct such as lean more realistic.
Epistemology	Epistemologically interpretive. Possibly anti-positivistic. Describes the real world. Its description is process and action based.	Mainly positivistic as it seeks to explain and predict what happens in the social world by searching for regularities and causal relationships between its constituent elements (Burrell and Morgan, 1979). Describes the structure underlying the real world in terms of quantity and rates.	Interpretive and rationalistic. Describes the real worlds in epistemological and ontological terms.
Human Nature	Either Voluntarism or Determinism. Adopts an intermediate standpoint which allows for the influence of both situational and voluntary factors.	It is deterministic as suggested by its design, approach and method of use. It is deterministic as it state that certain things or process must be in place for success.	Adopts an intermediate stand point which allows for the influence of both situational and voluntary factors in accounting for the activities of human beings (Burrell and Morgan, 1979). This is a better option of choice for this research and this will be the human nature philosophical stand of this research.

Methodology	SSM is ideographic as it is based on the view that one can only understand the social world by obtaining firsthand knowledge of the subject under investigation (Burrell and Morgan, 1979). Emphasis is on getting close to ones subject and exploring its detailed background and history and the subject or object of study is also allowed to unfold its nature and characteristic during the process of investigation to allow for careful and accurate analysis and for improvement (Burrell and Morgan, 1979). It is systemic and logical, links the human activity systems, seeks culturally feasible and systemically desirable changes in the real world. It is a continuously improvement methodology. A learning process which Clearly establishes the 'what' and 'how' transformation process performed in the real world to improve it.	A nomothetic approach to social science based upon systematic protocol and technique of analysis, as in natural science, which focus upon the process of testing hypothesis in accordance with the canons of scientific rigour (Burrell and Morgan, 1979). Problem solving quantifiable approach measures and accesses various option and possible change effect.	Systematic approach based on logically linked human activity systems that can rationalise cause and effect relationships. Searches for culturally feasible and desirable changes in the real world. Able to measure and assess the problematic and also the improved situation. It is a learning process that explains the problem situation and how it behaves and also explains what and how the transformation process tends to improve or alleviate the problem situation and how the improved situation would look like and behave.

Table 4. Ontological, Epistemological and Methodological Social nature comparison of SSM, Questionnaire and the use of the Triangulation (a combination of SSM & Questionnaire) (Improved and adopted from Burrell and Morgan, 1979 and Rodriguez-Ulloa and Paucar-Caceres, 2005).

The Triangulation method used include, study and analysis of existing literature, idiographic field observation within practical cases (Ethnographic research) and semi-structure interviews all carried out as part of the qualitative aspect of the Soft System Methodology in Triangulation. The quantitative part of the Triangulation was a survey done with the use of a questionnaire administered with returned usable response from seven groups made of One

Hundred and Seventy One Respondents. The analysis of the response was done using the Statistical Package for the Social Science (SPSS) now known as the Predictive Analytics Software (PASW).

5.6 RESEARCH FRAMEWORK

The framework for the research (see Figure 7) is divided into two major phases; the introductory phase and the Enquiry phase. The first phase which is the introductory phase starts with in-depth literature review and observation of lean system which leads to the building of a conceptual model. The research objective and question is an outcome of this phase. The second phase which is the main phase of the soft systems methodology in Triangulation is the idiographic field observation within cases which involves the use of survey method; semi-formal interview and soft systems methodology (see Figure 7).

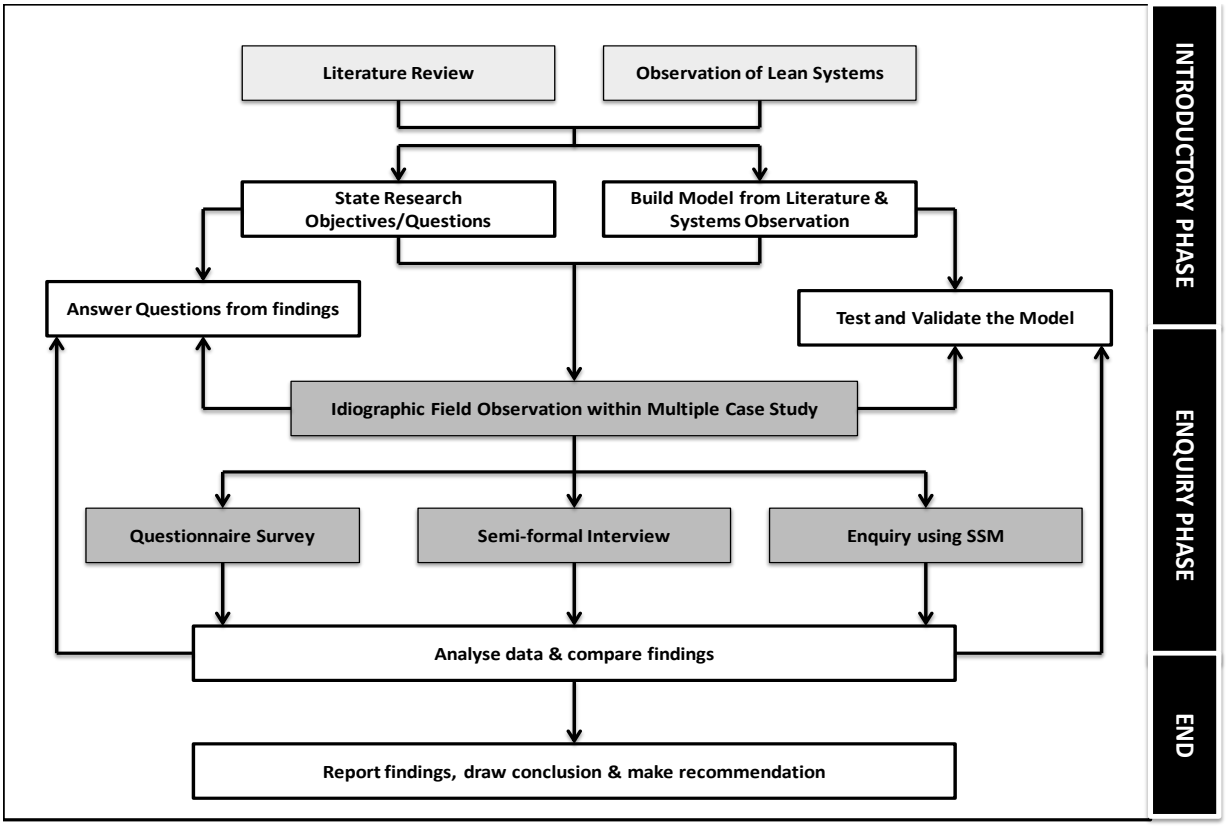

Figure 7. Research Framework

5.7 SUMMARY

This Chapter looks at the research methodology, reviews existing methods that have been used in previous research looking at the philosophical dimension. It takes a stand on triangulation as it preferred approach. It looks at Systems thinking from an epistemological point of view and sees the advantage of the Soft Systems Methodology in organisational process research from a philosophical and practical point of view. It adopts soft systems methodology in triangulation which is a midpoint between Interpretivism and Positivism from a system thinking perspective. The research framework is also described. The framework shows that the research methodology which is the Soft Systems Methodology (SSM) would be triangulated by the use of Questionnaire Survey and Semi-formal Interview. The findings, conclusions and recommendations from this research would be based on the Triangulated research approach.

CHAPTER 6: THE ACTION RESEARCH

6.1 INTRODUCTION

The action research was an active participatory idiographic field observation spanning a year and two months. During this period, the researcher was invited to actively participate in the deployment of the Lean philosophy in four organisations. A Brief Background of these organisations is given in Table 5.

Company	Brief Background
ENIC (Energy International Company)	A multinational energy company based in Nigeria.
ILMM (Industrial Laundry Machine Manufacturing)	A Europe based industrial laundry machine manufacturing company with market in the South-eastern Europe, Western Asia, the Gulf region and Mediterranean Africa.
SCT Government Agency	A government agency for research and development based in Nigeria.
MET Ltd	A pharmaceutical company based in Nigeria.

Table 5. Brief background of organisations used in the Action research

6.2 THE ACTION RESEARCH AT ENIC (ENERGY INTERNATIONAL COMPANY)

ENIC is a multinational energy company with over five hundred (500) staff based in Nigeria. Its operations span a vast majority of the energy business concerns and areas covering major energy locations in Nigeria. The company is part of a multinational energy group with branches in over fifty (50) countries. The company deployed the Lean philosophy into its Nigerian unit in 2010. The organisation saw the deployment programme as a great opportunity for continuous improvement of identified areas. This research looks into the Lean implementation in three areas where the organisation had challenges but saw opportunities for improvement. The opportunities for improvement were in the 3 areas of;

- Optimisation of Offshore Vessels,
- Creation of Store Space,
- Crane maintenance challenge.

Lean was deployed to this area using the Lean LPPO implementation model and applying the suitable lean tools.

6.2.1 Optimisation of offshore Vessels

Energy International Company (ENIC) deployed Lean in its offshore operation in a bid to optimise the use of its leased vessels. The total number of leased vessels covering its offshore operation was thirteen (13). The LPPO implementation model was used with the 'P' PROCESS aspect of the model following the DMAIC (Define, Measure, Analyze, Improve, and Control) roadmap laid out as a standard for lean in the organisation.

The organisation's leadership vision for the improvement process was to have reliable, efficient and fast moving leased vessels that will always provide reasonable coverage for the companies operation. The organisation's leadership showed its commitment to this vision by appointing an internally trained Lean expert to facilitate the improvement process. A champion for the improvement process was also appointed from the management team.

An implementation multifunctional team made up of process owners and the facilitator was set up. The team knew what was expected of them, they had the competence to decipher challenges and suggest possible solutions from data, observations, interview and practice. They had been empowered by the management to implement continuous improvement changes where necessary.

The activities planned as part of the lean implementation process include, interviews, historic and current data gathering, data analysis, process mapping and analysis, confirmation of findings, recommendation and implementation improvement changes recommended. The process owners were interviewed as part of the fact finding to know what their challenges were in their current state and what can cause possible improvement that would ensure better utilisation of the vessels. Opinion varied from better route planning for the vessels to proper scheduling and even better maintenance for the vessel. Figure 8 shows a rich picture of the various opinions.

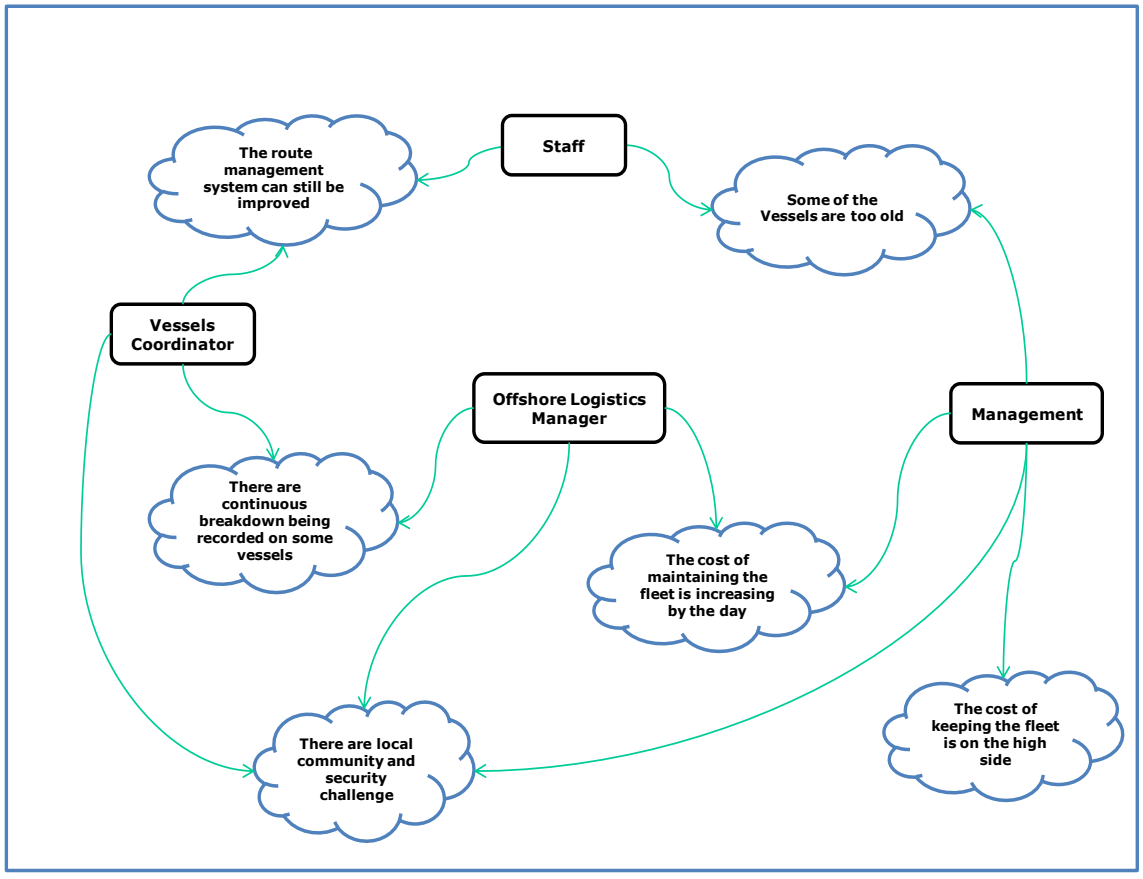

Figure 8. Soft Systems Rich Picture of the various opinions

Further enquiry into the problem situation was made as historic data were sourced, gathered and analyzed (see Table 6, Figure 9, 10, 11 and 12).

S/No.	Vessels	Annual Cost ($)	Speed (Knots)	Ave. Breakdown/year
1	Lady Isi	355,500	30	2
2	Lady Ogo	680,250	5.5	1
3	Black Tetra	700,000	5.5	5
4	Lady Ify	340,800	5.5	1
5	Archer Fish	370,300	30	2
6	Black Fish	200,600	18	1
7	Niger Surfer	324,000	22	2
8	Benue Surfer	324,000	22	2
9	Sea Robin	210,000	22	6
10	Amur Pike	250,000	22	4
11	Atlantic Cod	200,900	18	1
12	Queen Elizabeth	350,500	12.5	1
13	Gourami	338,615	8	1

Table 6: Vessels annual cost, speed and breakdown details

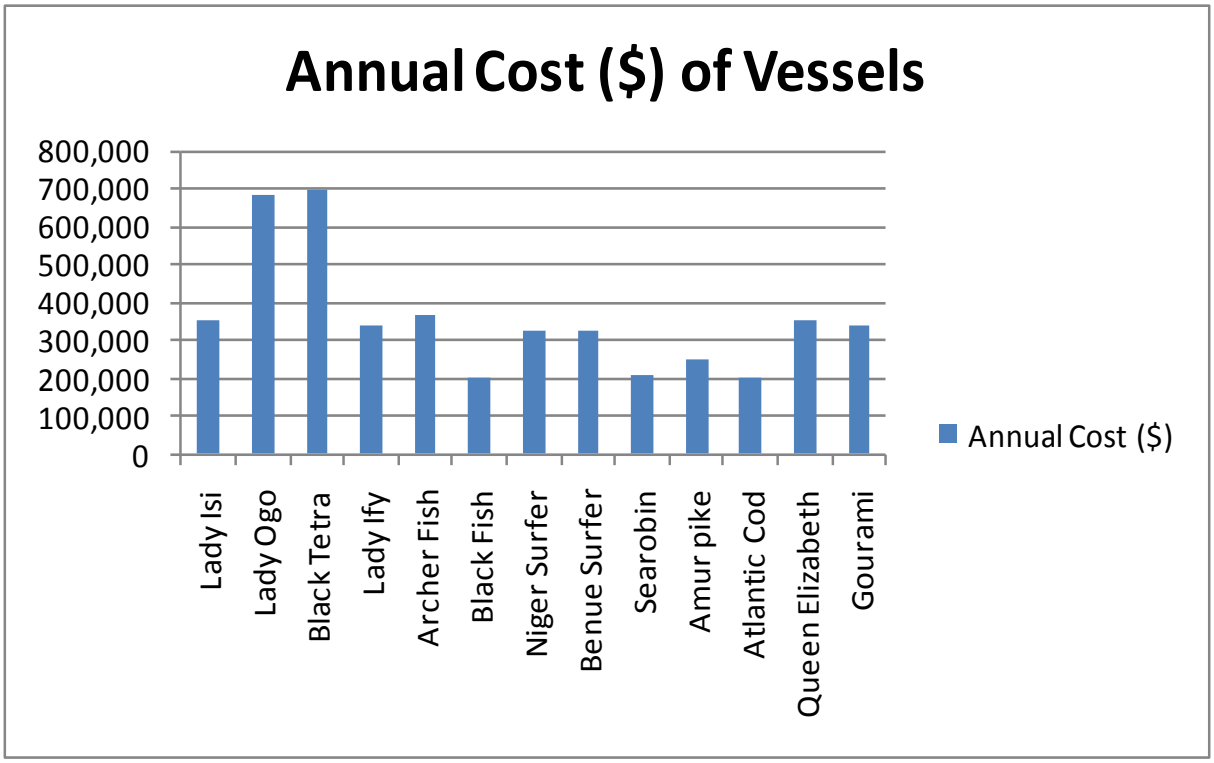

Figure 9. Annual Cost ($) of Vessels

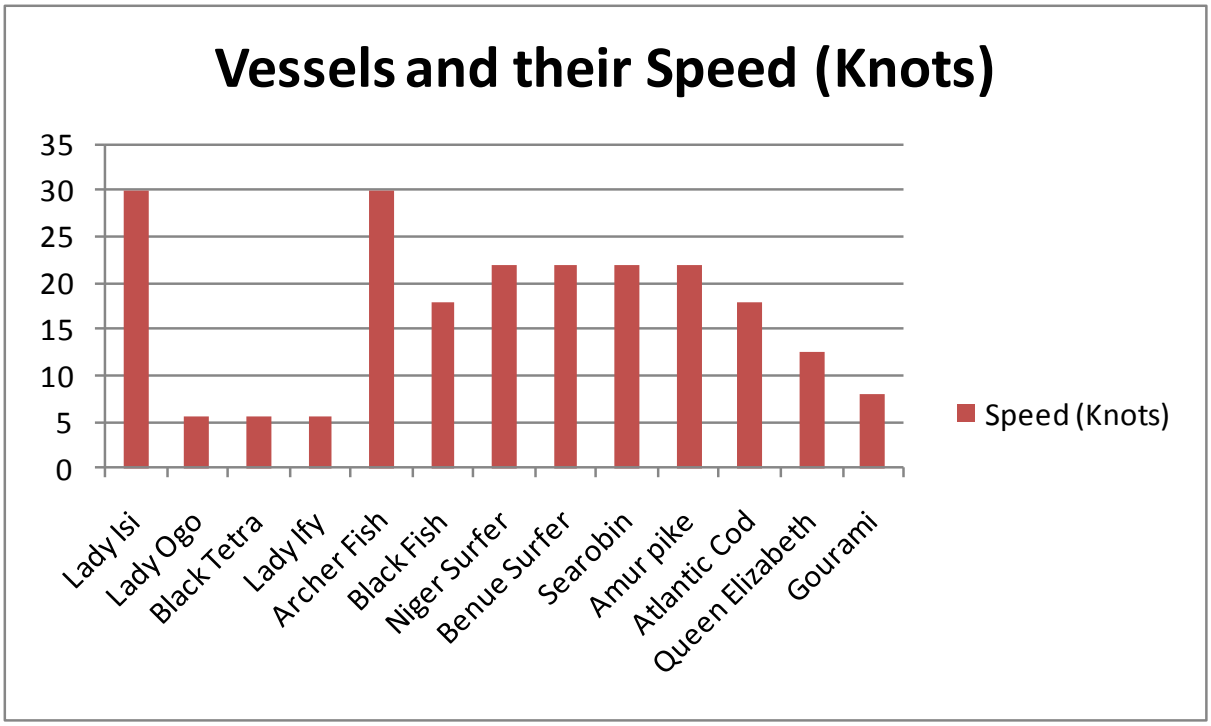

Figure 10. Vessels and their Speed (Knots)

The implementation team walked the process and carried out more investigation on the current state while reviewing the data. The team did the utilisation analysis for the vessels and discovered;

- Black Tetra vessel was not economically viable due to the cost implications and the regular breakdown and repairs which was very challenging.
- Sea Robin and Amur Pike were breaking down regularly. From the root-cause analysis conducted, it was discovered that both vessels were the oldest in the fleet and were due for possible replacement.
- Finally, the utilisation analysis revealed that with better vessel route planning and scheduling, just ten (10) vessels in the fleet will be optimal for operations.

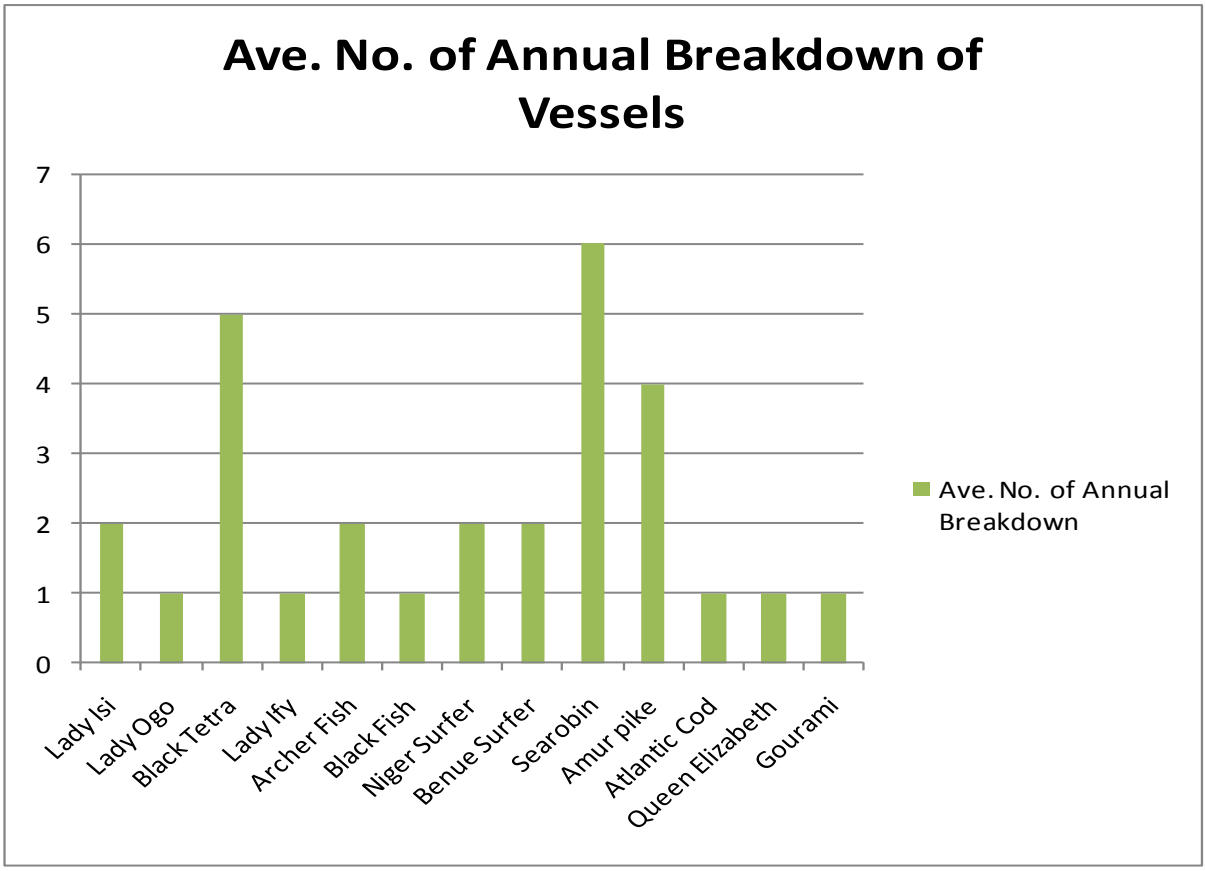

Figure 11. Average Number of Annual Breakdown of Vessels

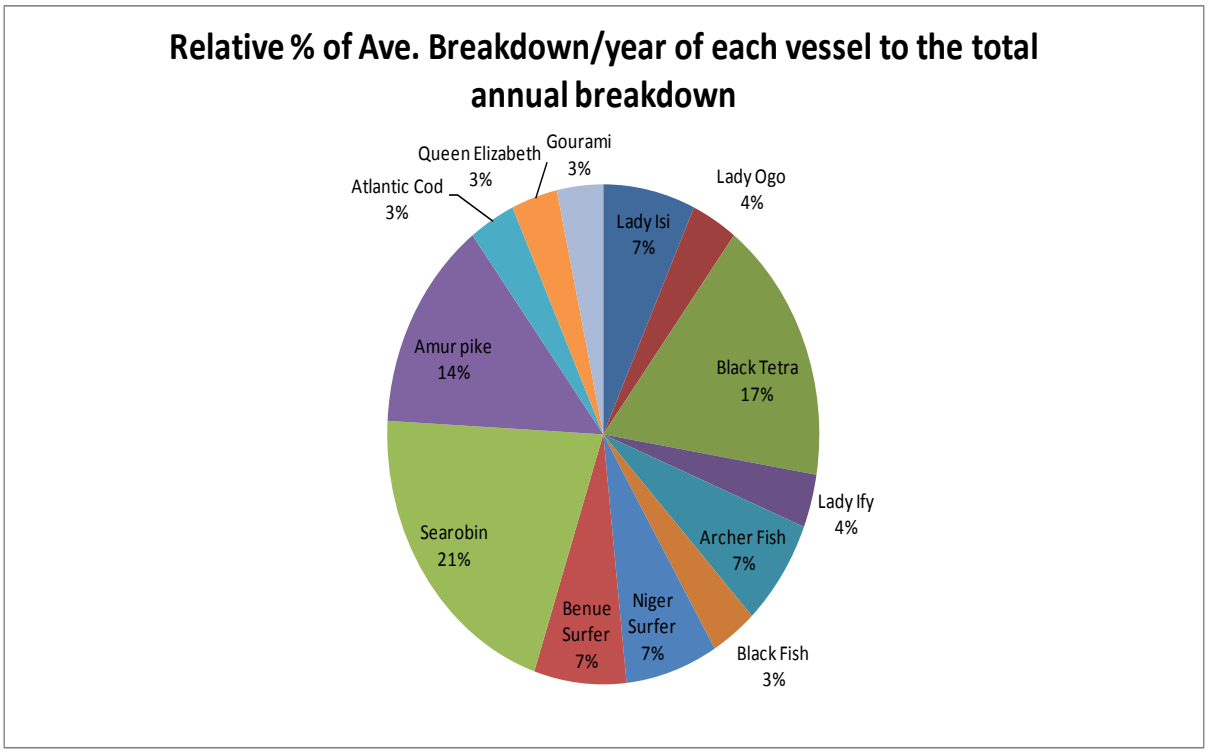

Figure 12. Relative % of Average Breakdown/year of each vessel to the total annual breakdown

6.2.1.1 Soft Systems Methodology Conceptual Model

An SSM conceptual model for possible improvement was proposed (see Figure 13) to validate and implement the finding from investigation (observation and data analysis).

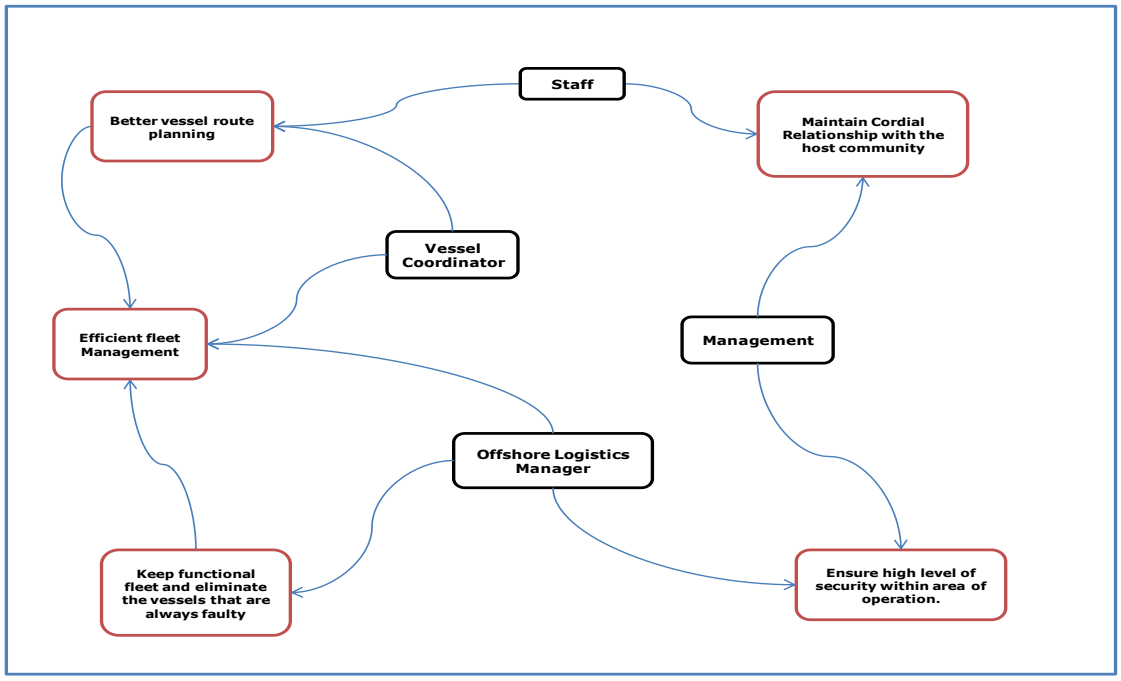

Figure 13. The SSM Conceptual Model for Offshore Vessels Optimisation

The recommendations that Black Tetra, Sea Robin and Amur Pike be withdrawn from the vessel fleet were made and the implementation was approved after proper route planning and vessel optimisation schedule have been developed and tested. The new vessel movement plan, optimisation of vessel schedule and withdrawal of Black Tetra, Sea Robin and Amur Pike would result in an expected annual saving of $1.2 Million. During the first three months of observation, the improved system was working well and the expected cost savings was well on the way of being achieved.

6.2.2 Creation of Store Space by 25% reduction of existing inventory

The gas production arm of Energy International Company (ENIC) needed a new warehouse to store chemicals for its new operations within its existing production area. $62 million was budgeted to be spent to locate and hire a new warehouse within a maximum of 100kms from operation area. At a management team meeting, it was decided that a lean implementation team be set up to find ways of possibly reducing the cost budgeted for the hire of a new warehouse and the management was committed to seeing that the team succeed in reducing the cost of the new warehouse to be hired. The team was made up people from the logistics and warehouse section of the company.

The team decided to carry out some investigation on what the current actual storage capacity in terms of store space in the operation area and what is actually in the store. They also asked the process owners and users about their opinion on the warehouse management. The opinions of owners and users are expressed in a rich picture in Figure 14.

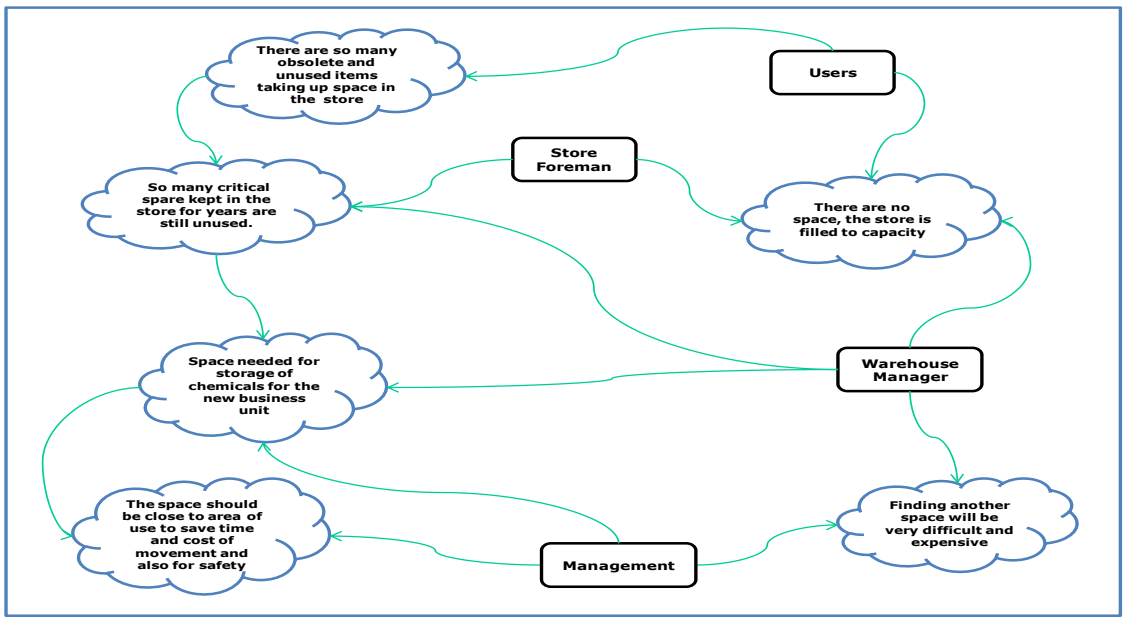

Figure 14. SSM Expressing the Problem Situation

The team decided to start the improvement process by carrying out a 5S on the existing warehouse (see Figure 15 for the conceptual model for the 5S continuous improvement system). The first three weeks was spent on a detailed count of what was in the warehouse. All items in the warehouse were marked out clearly stating when they came into store and when they were last ordered for use by the user department. All the items that had not left the warehouse for 5years or more which amounted to 13% in the warehouse were tagged with red and kept together. Various parts and critical spares (amounting to about 16% of items in the warehouse) which have been in shelve for less than 5 and not more than 2 years were tagged with yellow and put together in one area of the warehouse and fully listed. The list was then sent to the user department for confirmation if they are still needed and when it will likely be used. The user department were given 2 weeks to reply and conduct test on some materials that seems to have degenerated or are obsolete.

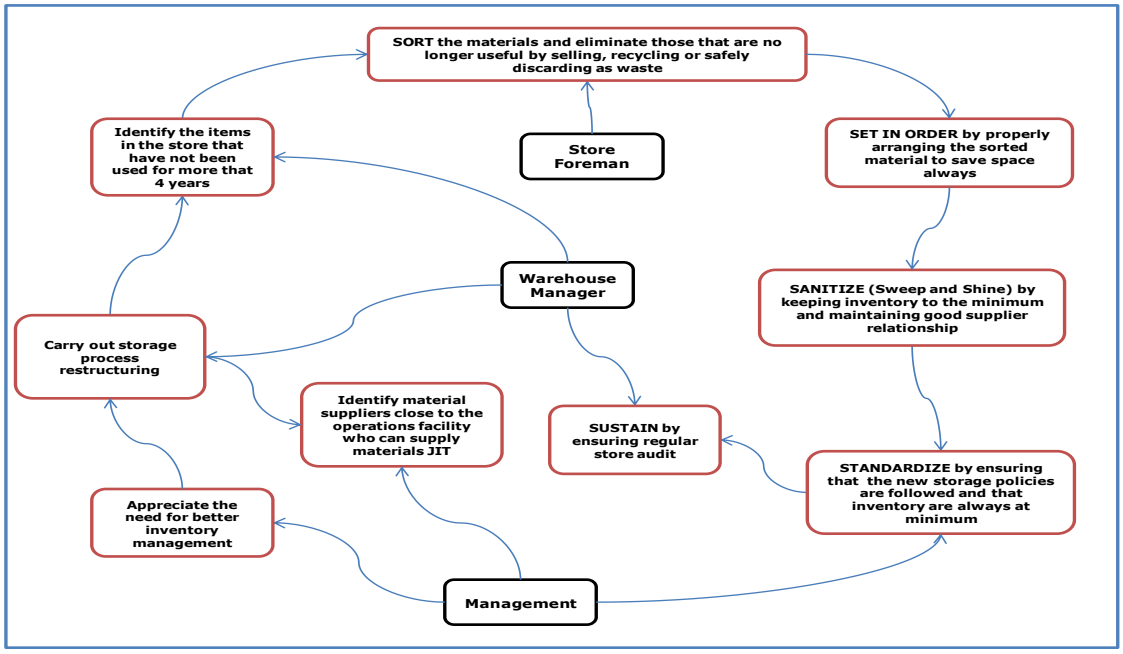

Figure 15. The SSM Conceptual Model for the Warehouse 5S continuous improvement system

In the 5th week, the user department completed the verification of items (tagged red and yellow) occupying 29% of the warehouse floor area that had been on the shelves for 2 years or more without being used. This was in compliance with the instruction from the lean implementation team. From the verification, it was discovered that goods occupying 2% of the floor space were either bad or obsolete. Part of the items occupying 18% of the floor space may not be used within the next one year as stated by the user department. While the remaining items occupying 9% of the floor space were critical spares and other item of high level importance that could be used within the year.

In the 6th week, 20% of the warehouse space already freed and empty as the '2% obsolete items' and '18% 2 years and above items that may not be used within the next 1 year' (tagged yellow and red) were removed from the warehouse.

The warehouse was then cleaned up (5S-Shine) and all the materials where now set in order. After setting in order, another 5% of the floor area was gained amounting to a total of 25% of the floor area of the existing warehouse gained by the 7th week. This floor area gained was enough to accommodate the space for the chemicals. The warehouse arrangement was standardized using a computerised system of inventory management. This gain was sustained as full scale renovation for the chemical use commence on the freed space by the 9th week.

A safe, protected area that met the safety storage regulation for the chemical was created on this gained space. Less than $1 million was spent to meet the safety requirement and create the safety environment needed for the chemical storage. The chemical storage area was ready for use in the 14th week. The implementation of Lean using the LPPO model for

this project resulted in a benefit of over $61 million which was not used for the hire of a new warehouse as planned in the budget.

6.2.3 The Crane Maintenance Challenge

Operations at ENIC (Energy International Company) require the use of Cranes for lifting and other movement of materials, equipments and other needed resources. The company has a total of 97 Cranes. Offices and areas of operations are both offshore and onshore. Every area of operation requires the use of one Crane at the list. These Cranes must undergo periodic preventive maintenance (PM) as stipulated by international and local regulations. The preventive maintenance (PM) jobs are carried by the company's team of certified crane technicians and engineers.

The company prides itself on its tenets of high standards in safety and facility integrity. In keeping to this tenet, the company carries out monthly preventive maintenance (PM) on all its Cranes. But, by international standards and local regulations, only 10 of the 97 Cranes require monthly preventive maintenance (PM) due to the frequency and nature of use. The other 87 Cranes only require quarterly preventive maintenance (PM).

In the previous year, the company had a total of one hundred and fifteen crane preventive maintenance jobs not completed due to a perceived shortage of manpower. In addition, there had been a high number of unscheduled repairs which caused an increase in the percentage of "break-in-schedule". The company had resolved to meet all its preventive maintenance obligations even as it acquired more cranes to meet the growing needs of its operations. The company as part of its deployment of the Lean philosophy in its processes decided to internally seek ways of using the methodology to explore the Crane maintenance

challenge by optimizing the available resources and eliminating waste to meet their preventive maintenance (PM) obligation and carry out other operational duties.

6.2.3.1 Problem Defined

At the inception, the researcher and other members of the implementation team looked at details of the project. The Problem/Opportunity Statement was clearly stated, the project scope and defect were defined while the metrics to be improved were established and documented.

The team then proceeded to state what they intend to improve on in terms Output metrics considering present inputs. This resulted in the IPO (Input-Process-Output) diagram (see Figure 16).

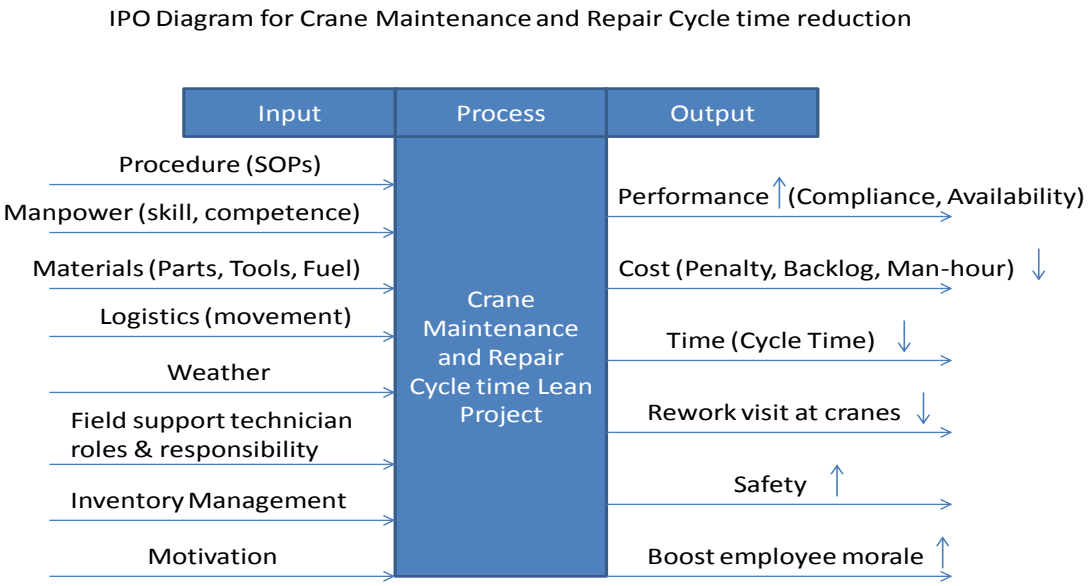

Figure 16. IPO Diagram for Crane Maintenance and Repair Cycle Time Reduction

A joint problem solving efforts was made by bringing together diverse points of view from individual team members and process owners (Kristal et al., 2010). These effectively increased the understanding of the process and thus expanded the total pool of knowledge

for tackling the complex challenge (Huang et al., 2008; Kristal et al., 2010; Linderman et al., 2004). To this end, twenty members of the mechanical support and crane group were interviewed to find out what their challenges were and how they felt it could best be solved. This gave some great insight on the challenges and also the employee morale got a boost as they felt their voice is being heard by management whom they now rightly perceive as caring. Figure 17 shows a Pareto Chart of their opinion.

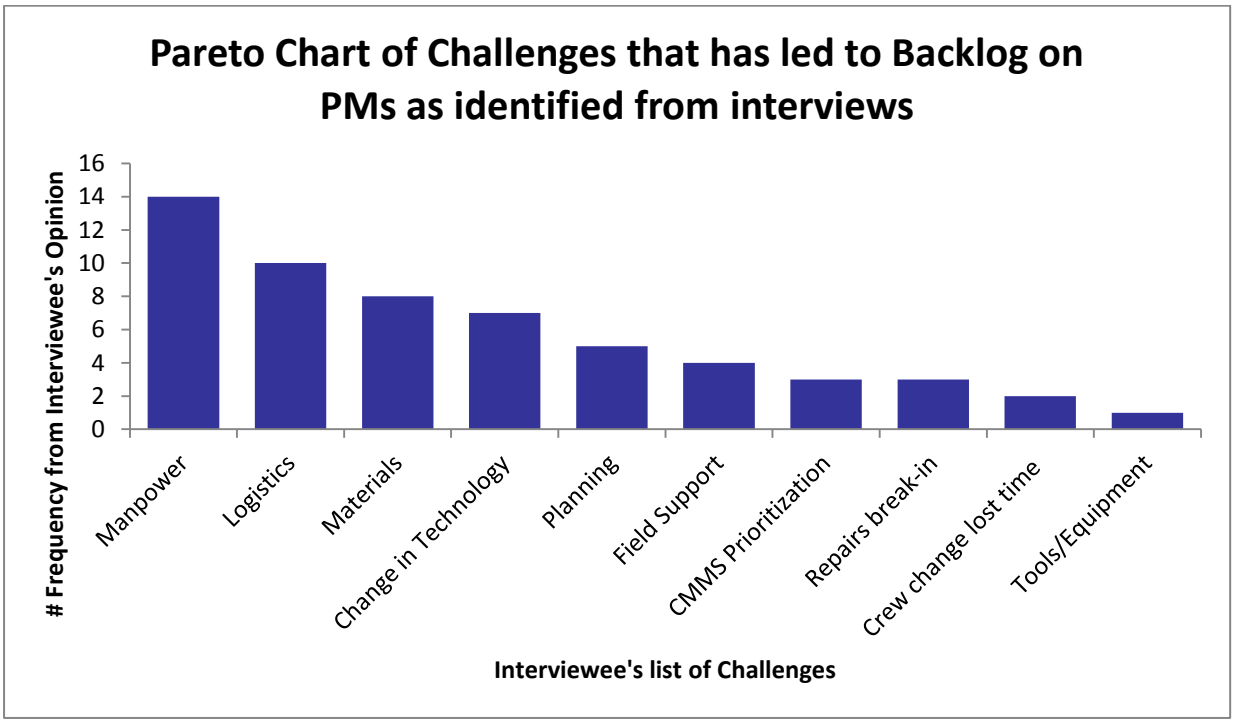

Figure 17: Pareto Chart of Challenges that has led to Backlog on PMs as identified from interview

The Pareto chart shows 'Manpower' and 'Logistics' as the significant few. On the Logistics, crane technicians on field work where to now stay over at live-in platforms for PMs that will last more than a day. This will save a day or more man-hours from excessive travel time used in 3-4 days continuous to and fro movement for one job. On the Manpower, only one crane technical expert should now be sent to areas where there are field technicians that can assist in PMs rather than sending two. This frees up an extra expert who would do other waiting professional jobs. Next was process 'time observation' (see Figure 18).

TIME OBSERVATION

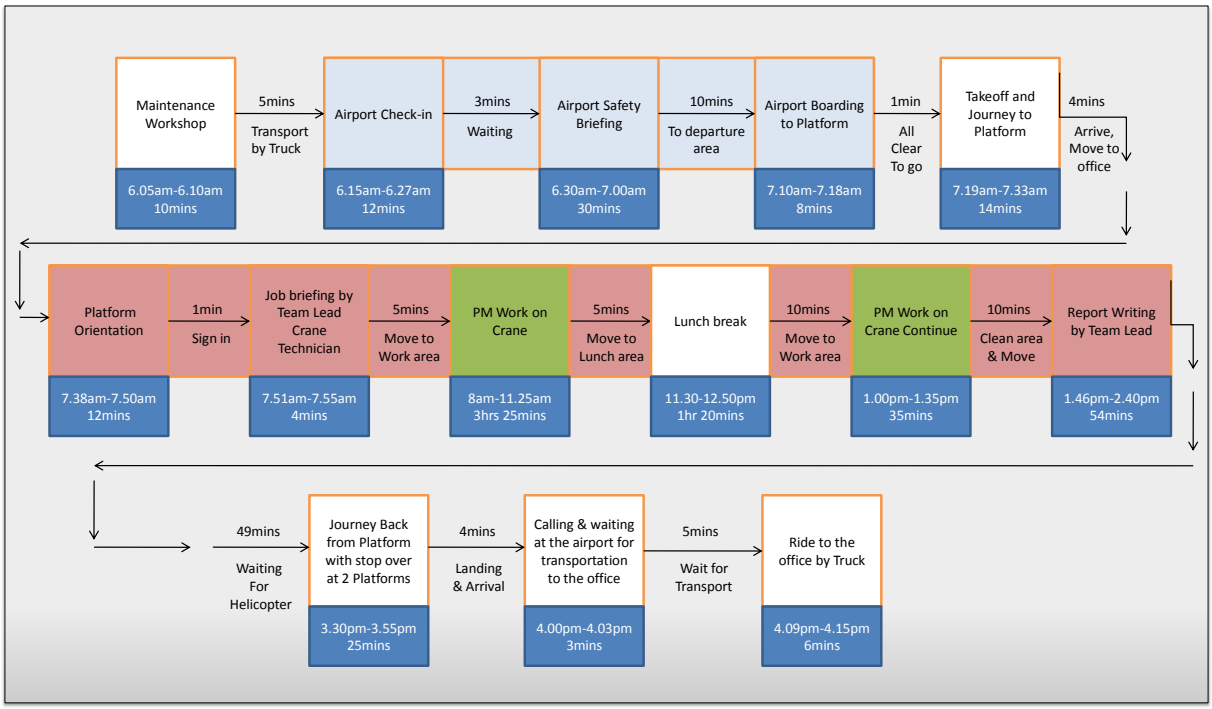

Figure 18: Time Observation at Platform

Findings from the time observation showed that about a third of the total man-hours or less than 50% of the daily manpower for PM (Preventive maintenance) were actually spent on value adding activities on the Job. Most of the time was either spent on travels or other logistics aspects which are non value added (see Figure 18 for the time observation study). While studying the actual process flow of work order for crane maintenance, a current state process flow diagram of what was actually happening in the process was drawn (see Figure 19). The drawing provided a clearer picture of how prioritisations of Jobs are done and what influences the work order priorities which may cause “break-in-schedule” of already planned preventive maintenance job.

Crane Maintenance Current State Process Flow Diagram

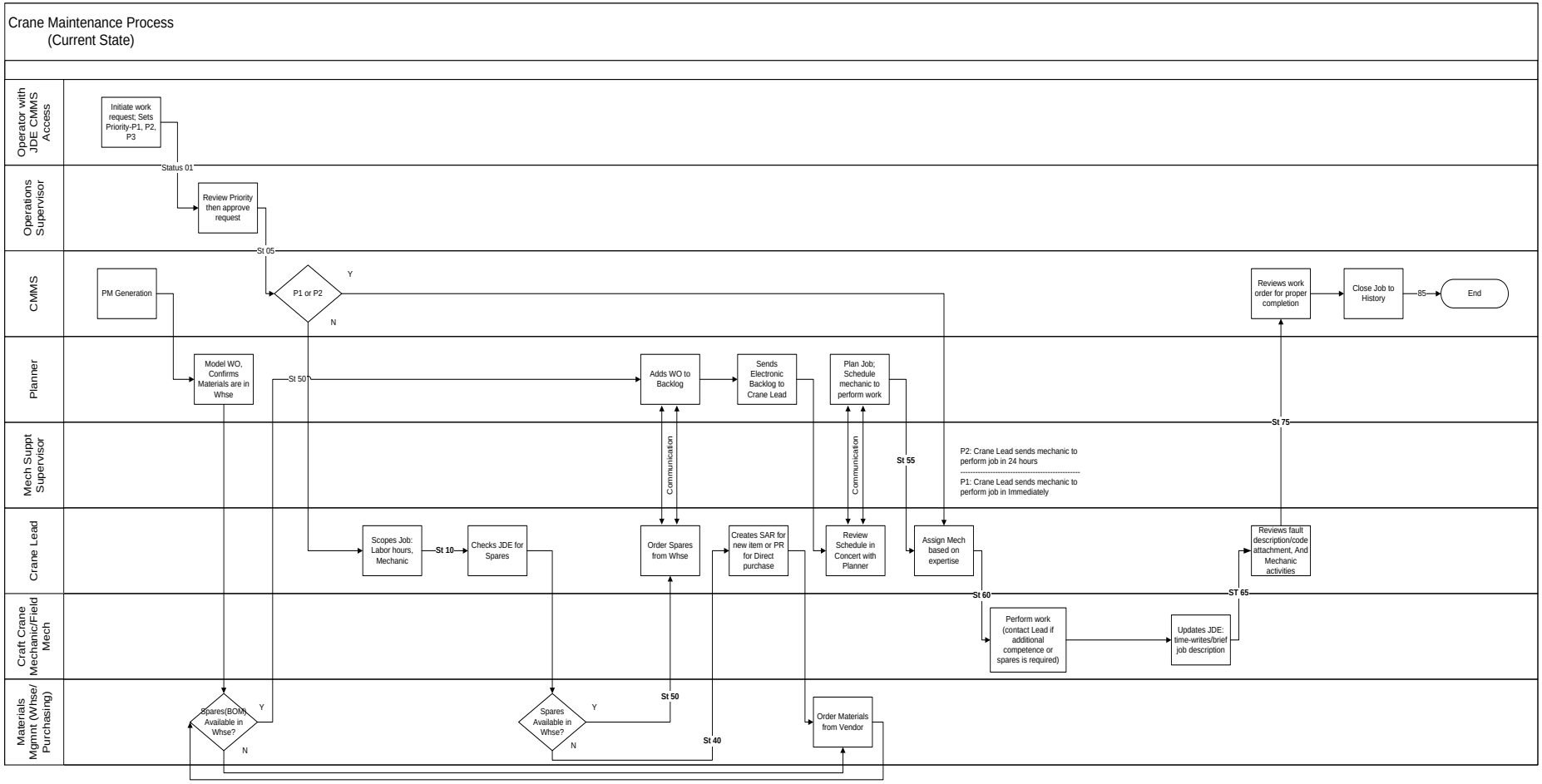

Figure 19: Crane Maintenance Current State Process Flow

6.2.3.2 Analysis of the Problem Situation

With interviews conducted and "the process walked" there was a clearer picture of what the challenges were in meeting up with operation service requirements (Figure 20 shows the soft system rich picture of the initial state).

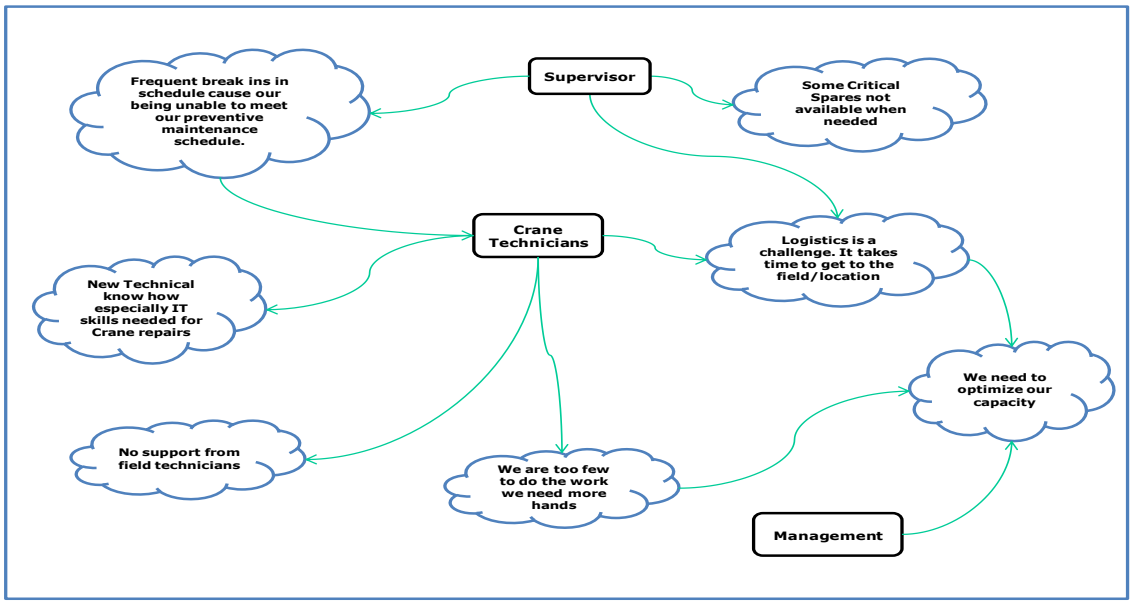

Figure 20. Soft Systems Rich Picture for Initial State

The team then had further discussions and interviews with maintenance service providers and users on the causes of the existing challenges and their possible effect. A fishbone diagram was developed as shown in Figure 21 from the analysis of the discussions, interviews and observations from "the process walked".

The fishbone diagram (see Figure 21) shows that the crane maintenance teams challenge to meeting their operational obligation as at when due stem from various areas amongst which are; the challenge of not have enough support from field technicians to the competency challenge due to the constant change in crane technology. There was also the logistic challenge which included long man-hours spent on travels to none availability of

FISHBONE DIAGRAM ON CRANE PM FROM INTERVIEWS & OBSERVATION

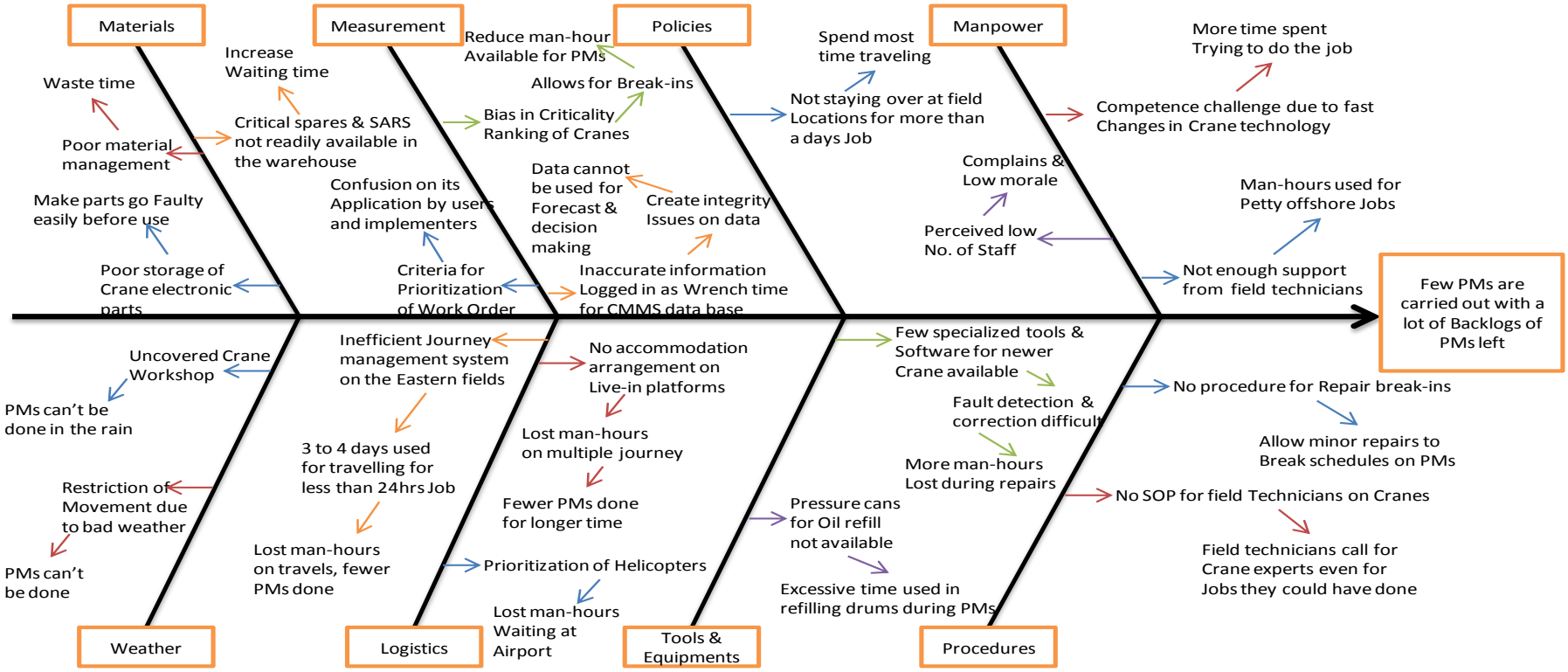

Figure 21. Fishbone Diagram on Crane PM Interviews & Observation

accommodation at platforms. Materials management for parts was also a challenge as some critical spare parts for the cranes were not readily available and do take months to arrive when ordered. Some materials being used for repairs and maintenance were also not being stored in the way and manner expected to preserve them. The crane maintenance workshop was also uncovered and this has created a challenge during the raining season as the weather element comes into play and no job could be done on a crane when it rains. There was also the job planning and procedure challenge which had to do with how the planning team assigns weekly jobs to the crane team using the "priority" placed on each job request. The "priority" lists from the planning team do sometimes conflict with the crane lead's plan on how the team capacity can best be managed for each week. This meant there was a need for the planning team to fully involve the crane lead in the weekly "prioritisation" of crane jobs to ensure efficient manpower utilisation.

From random sampling of work orders about to be closed out, it was observed that 25% of the Jobs in the previous three months were placed on a higher priority (P1 and P2) than they ought to be, thus resulting in avoidable break in Preventive maintenance schedule (PM schedule). We had to see what we could do in the process flow to enable the crane team gain more productive hours for preventive maintenance (PM) Job by reducing irrelevant break-ins, thus conceptually SETTING IN ORDER the job priorities to optimise the use of available man-hours. So, we looked at the current state process flow (see Figure 19). After a careful study, an 'immediate approval of the Maintenance Superintendent' which guaranteed adequate check on priorities was included in the process (see Figure 22 the future state Process Flow Diagram). It was the change agent needed to effectively check actions resulting in unnecessary break-ins.

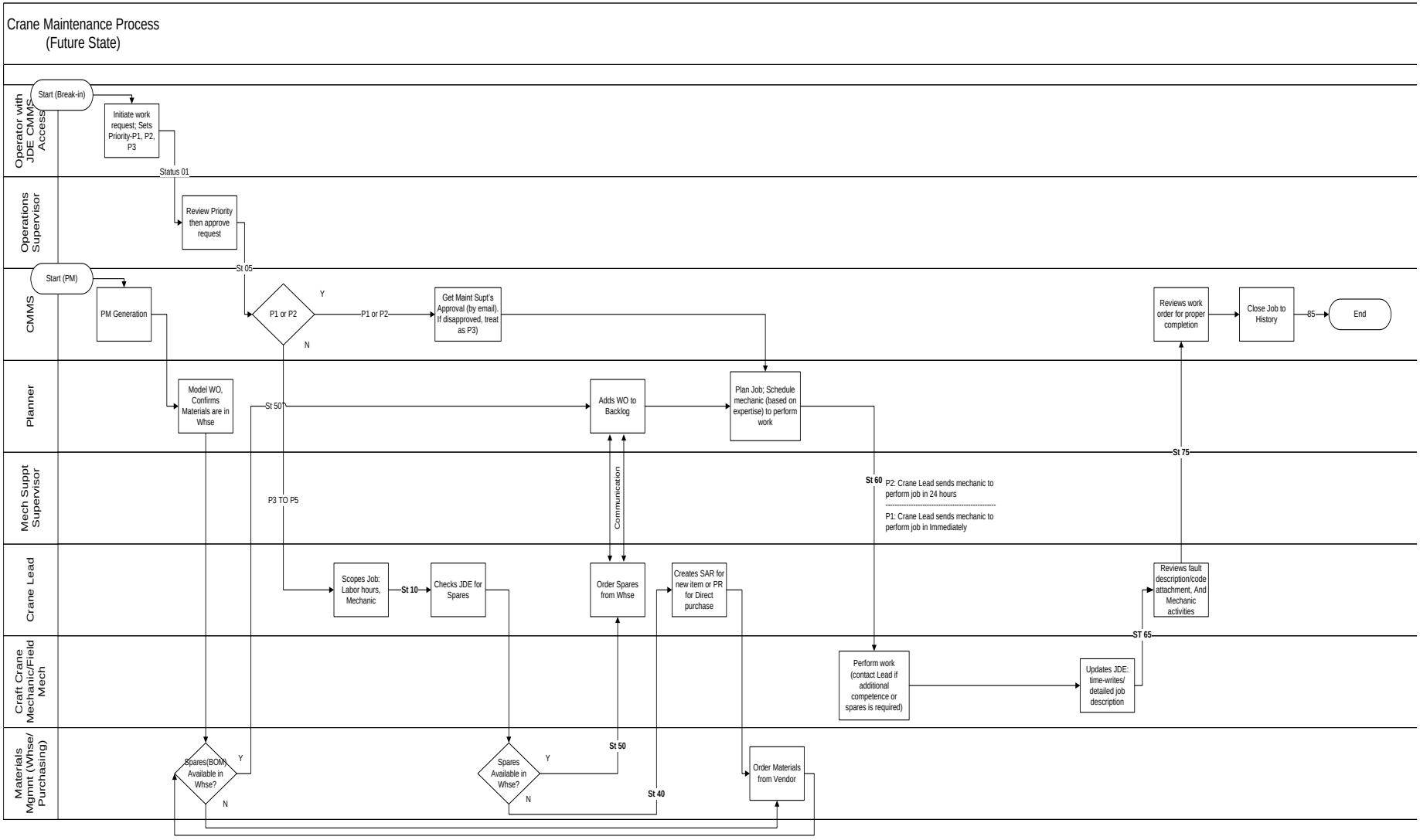

Figure 22. Crane Maintenance Future State Process Flow an improvement

With the introduction of an 'immediate approval of the Maintenance Superintendent' which guaranteed adequate check on priorities in the process, two steps and three handoffs were eliminated in the proposed future state process for maintenance work order priority scheduling. This is Lean thinking, just do it (Womack and Jones, 2003). We had to Map the entire process flow find the possible constraints and create a change agent that will effectively check actions resulting in unnecessary break-ins and the 'immediate approval of the Maintenance Superintendent was this change agent.

6.2.3.3 Improvement Process Conceptualised

From observations and findings from 'the walk through the process' a conceptual model for improvement was designed using 5S in SSM conceptual modelling see Figure 23.

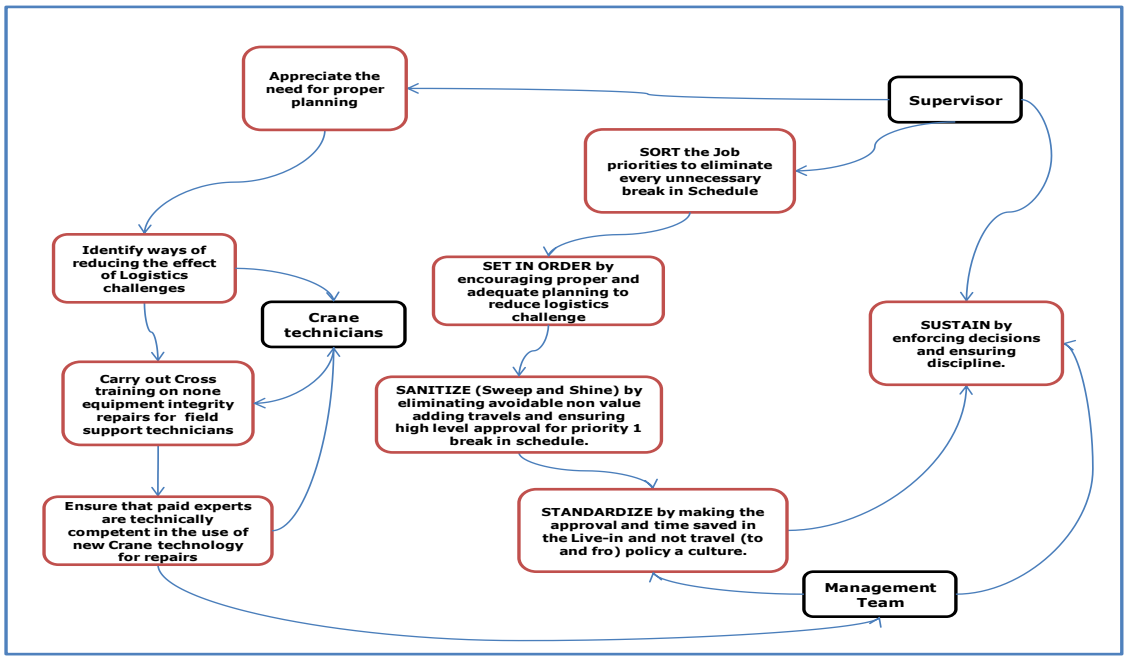

Figure 23. The SSM Conceptual Model for Improvement

From information gathered and understanding gained from walking the process, it was time to eliminate waste and optimise the current resource and processes. Based on findings, the team made changes on travel and logistics for PM (Preventive Maintenance) Jobs to be

carried out on platforms for more than one day. This was intended to save a day or more man-hours from excessive travel times used in the three to four days continuous to and fro movement for one Job. For monthlies or quarterly PMs, buddies were sourced from the fields freeing up one crane technician. All necessary job prioritisation approval and checks were put in place and immediately implemented. These changes reduced travel time and resource allocation which effectively increased Crane technicians' productivity by two (2) to four (4) times.

Supervisors enforced the improvement decisions which were arrived at in the Lean implementation team meeting with the responsible supervisors. Within sixty days of implementation there was visible improvement as more PMs were done with fewer break-ins.

6.2.3.4 Control to Check and Sustain Improvement

The Continuous improvement work being done was being monitored, with the necessary metrics which will enable us factually analyse the performance to see how positively or negatively our improvement have affected the system. The work measurement metrics include crane unit Job Schedule compliance (see Figure 24), Break-in work order metric (see Figure 25) and Scheduled PM compliance (see Figure 26).

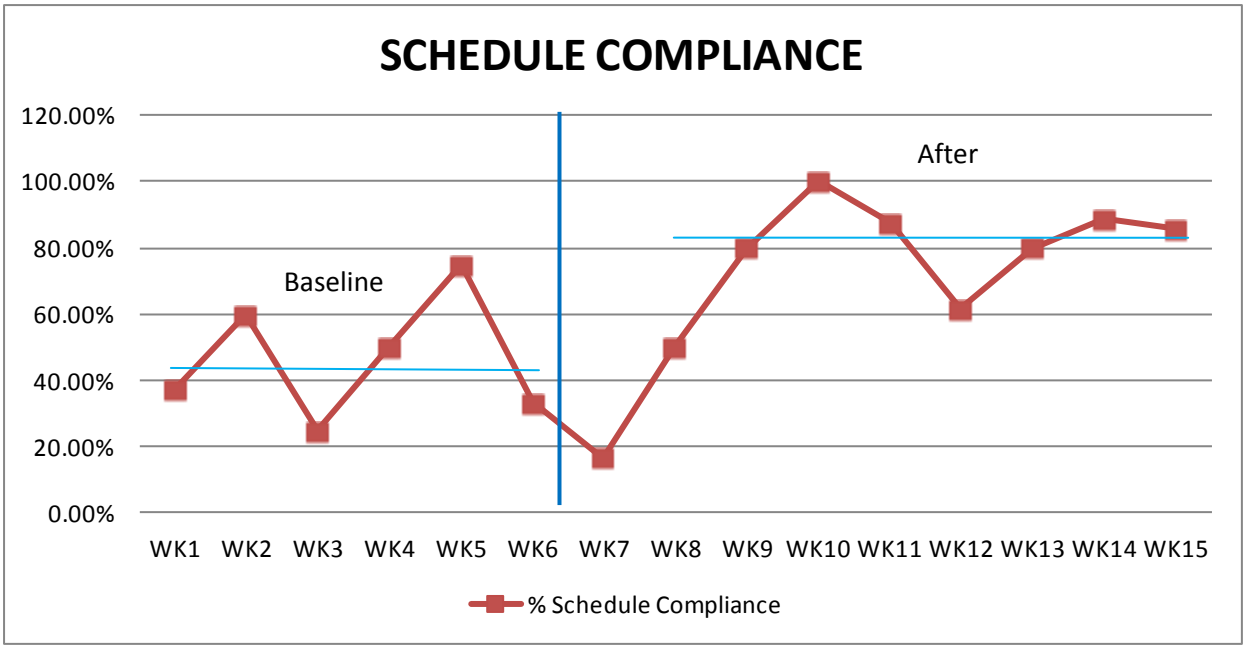

Figure 24: Crane Maintenance Work Schedule Compliance

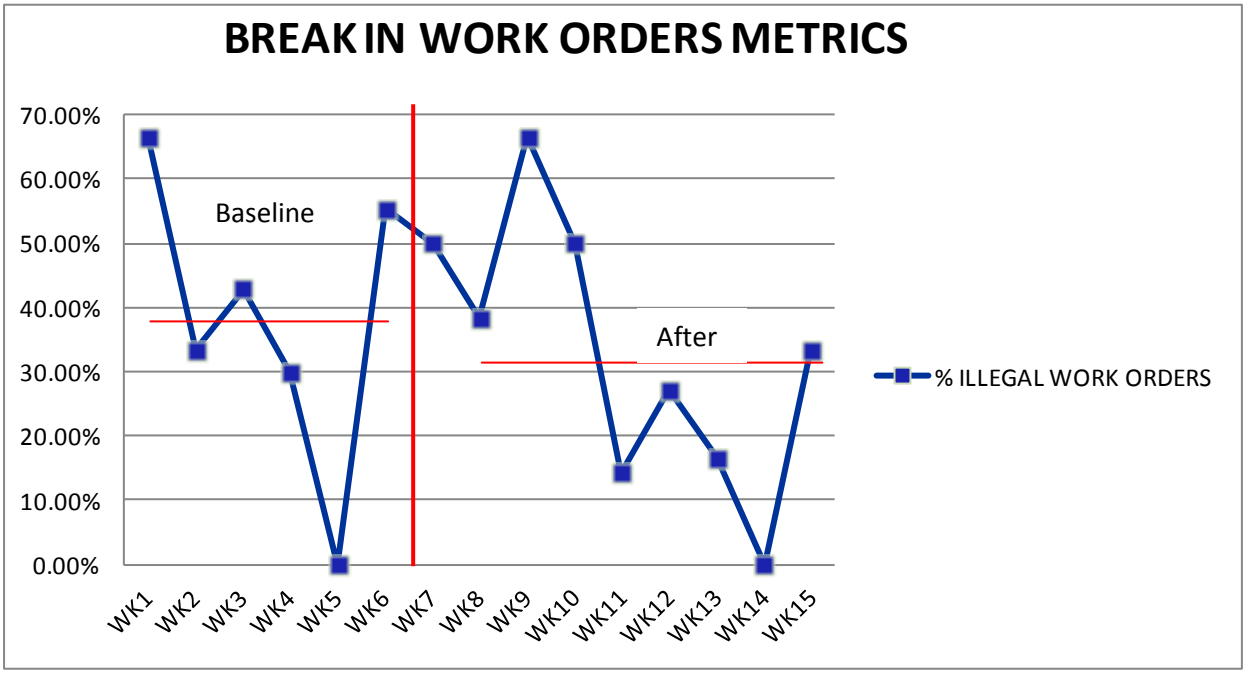

Figure 25: Crane Maintenance Break in Work Order Metrics

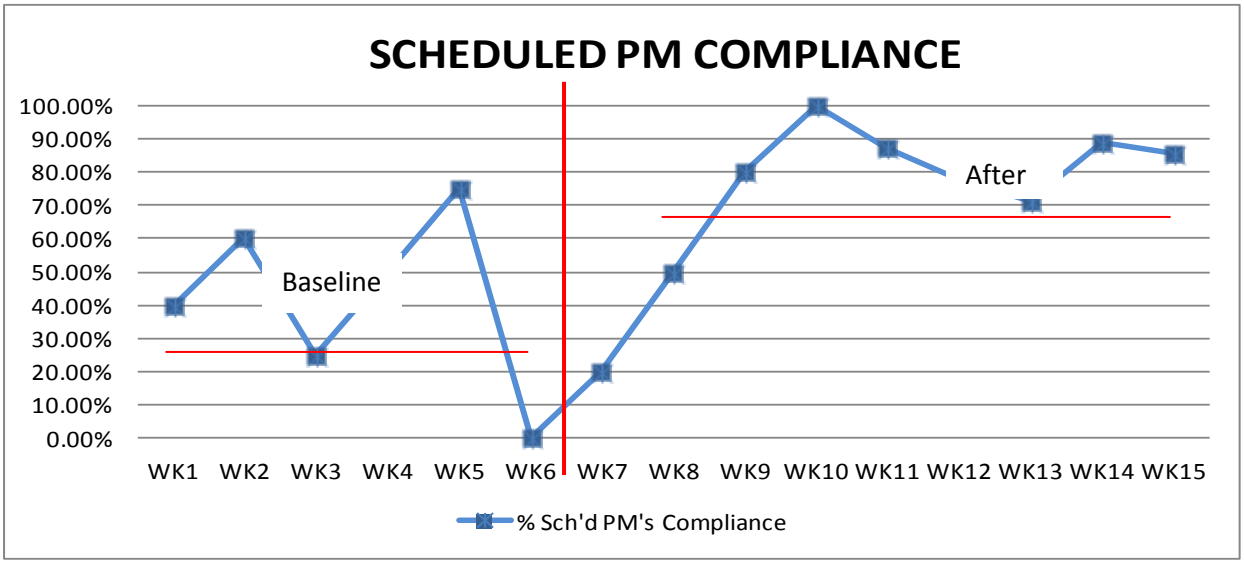

Figure 26: Crane Maintenance Schedule PM Compliance Jobs

The shedule compliance showed that the crane team were only able to meet up with 35.50% of the sheduled jobs as at week 1 of the year (see Table 7). By week 7 before the implementation of Lean Six Sigma improvements, the work shedule compliance was at 43.75%. This rose to an average of 85.71% compliance after the improvement with the compliance level at 85.71% at week 15. Showing an improvement of over 80%. The break-in work order also reduced from an average (baseline) of 38.10% before the improvement measure implementation to 33.33% allowing more scheduled job to be done. The metrics are continously being monitored as a control measure and also in a bid to see further areas for continous improvement.

CRANE IMPROVEMENT METRICS AFTER LEAN PROJECT

METRICS	AS AT WEEK 1	BASELINE BEFORE WK 7	MEAN AFTER WK7	AT WEEK 15 AFTER LEAN	% IMPROVEMENT	KPI TARGET
SCHEDULE COMPLIANCE	35.50%	43.75%	82.86%	85.71%	89.39%	80%
PM COMPLIANCE	40.00%	45.00%	82.86%	85.71%	84.13%	100%
ILLIGAL WORK ORDERS	66.67%	38.10%	30.30%	33.33%	20.47%	0%

Table 7: Crane Maintenance Improvement Metrics Baseline at Week1 showing improvement at Week 15 after Lean Implementation from Week6

6.2.4 ENIC Lean Implementation: Interview on the Lean Philosophy Deployment

At ENIC (Energy International Company), observations showed a system that had competence, organisation and experience in its lean deployment strategy. Although the organisation was large, almost everyone knew the basic idea behind lean and was all working for a continuously improving system. The company also had very visible lean deployment leadership support and had lean project intervention mechanisms and supporting infrastructures to ensure success. The results of its first wave of lean deployment in its various processes in six months had a success rate of 90% with various improvements such as; improved cycle time, improve manpower and schedule management, optimisation of offshore vessel use, cost and store space savings, and improved facilities and resource management.

At the end of the research event at ENIC, the researcher conducted a semi structured interview with two staff of the company. One was a top management staff and the other a supervisory staff (middle level worker) that is referred to as a senior staff. The interview questions were eight in all. They include;

1. Is the Company Lean?
2. How did the company come about this philosophical practice?
3. When did the Lean deployment start?
4. How did the deployment start (What were the initial steps at the beginning of the deployment)?
5. How has the system been thriving?
6. What have been the enablers?
7. What has been the outcome?

8. What have been the challenges?

Question 1, 2, 3 and 4 seek to know if the company is practicing lean, its history in the company and if there is the Top leadership commitment to Lean as a philosophy. Questions 4, 5 and 6 seek to know how they have deployed the programme. It seeks to know the influencing factors, the target areas, the people factor and the processes. Question 7 seeks to know the outcome while question 8 is aimed at finding out the challenges faced from the philosophical implementation of Lean in the organisation.

Key words that were looked out for in the course of the interview were words that have been proven from existing research to be consistent with the implementation of lean. Such words include Leadership (Achanga et al., 2006; Anand et al., 2009; Appelbaum et al., 1998; Boyer, 1996; Gudmundsson, 2004; Liker, 2004; Puvanasvaran, et al., 2009; Soriano-Meier and Forrester, 2002), People (De Menezes et al., 2010; De Treville and Antonakis, 2006; Liker and Morgan, 2006; Puvanasvaran et al., 2008; Shah and Ward, 2003), Training (Anand et al., 2009; Boyer, 1996; Houshmand and Jamshidnezhad, 2006; Puvanasvaran, et al., 2009), Process (Karlsson and Ahlstrom, 1996; Motwani, 2003; Rother and Shook, 2009; Sanchez and Perez, 2001; Womack and Jones, 1996), Continuous improvement (Ahlstrom, 1998; Karlsson and Ahlstrom, 1996; Knill, 1999; Sanchez and Perez, 2001; Singh et al., 2006; Womack and Jones, 1996), Empowerment (Blanchard et al., 2001; Boyer, 1996; Olivella, et al., 2008), Expectation (Upadhye et al., 2010a), Competence (Hillgren and Jacobs, 2009), Quality (Pfeifer et al., 2004; Shah and Ward, 2003; Shah and Ward, 2007; Womack et al., 1990), Just-In-Time (Shah and Ward, 2003; Shah and Ward, 2007; Womack et al., 1990), Teams (Boyer, 1996), Communication (Puvanasvaran, et al., 2009; Worley and Doolen, 2006), Supporting Infrastructure (Boyer, 1996), Planning (Monden, 1983; Niepce and

Molleman, 1996; Pfeifer et al., 2004; Rother and Shook, 2009), Motivation (Appelbaum et al., 1998; De Treville and Antonakis, 2006; Womack et al., 1990), Culture (Dahlgaard and Dahlgaard-Park) and Outcome (Buyukozkan and Ozturkcan, 2010; Cochrane, 2007; De Treville and Antonakis, 2006; Pedersen and Huniche, 2011; Scherrer-Rathje et al., 2009; Upadhye et al., 2010a).

6.2.4.1 Interview with the ENIC top management staff (ENIC TMS)

Researcher: Is this company Lean?

ENIC TMS: Yes. It is a strategic philosophy which has been adopted by the group globally and it is now being deployed into the Nigerian business unit. It is our global cultural practice to continuously improve in everything we do. We just want to get better and better.

Researcher: How did the company come about this philosophical practice?

ENIC TMS: The Company has been in it for over ten years now but the deployment in the Nigerian business unit is just about a year old. As I said earlier it is part of our global philosophy of continuous improvement in all we do. All we are doing now is creating the awareness to the grass root. Showing everyone the way it works and its short term and long term benefit. We are just making our system better.

Researcher: How did the deployment start?

ENIC TMS: It started with the top management meeting and agreement of the Nigerian business unit. It was followed by workshops for management and supervisory staffs. Awareness was also created at both departmental and general meetings. All the necessary infrastructure which included administrative and technical framework for the successful deployment was put in place. Specific areas of focus were identified by the various

departmental heads and facilitators to help in the improvement drive in these areas where appointed and trained. Mentoring was also provided for the facilitators. The expectations were clear from the onset. They were empowered by the top management to perform by facilitating the process owners' quest for improvement in the identified areas. We actually started with firm leadership commitment, development of adequate supporting infrastructure and effective people awareness.

Researcher: How has the system been thriving?

ENIC TMS: The system has been thriving with the commitment of the people. It is their process. They own it. So, the lean continuous improvement philosophical deployment is thriving because the people had made it thrive.

Researcher: What can you consider as the key process enablers?

ENIC TMS: As an expert with over ten years experience in lean deployment, I can say with a great level of certainty that having technically competent staffs in their various fields is very important because you cannot improve what you do not know. This is what I would term having the right people. Selecting the right areas to focus on at each time is also crucial because there is need for it to be visible to the business and to the customers. The right lean project should be measurable, operate in a repeating cycle, visible to all, within the span of internal control and must have some financial or soft value. There should be effective and efficient communication structure within the system with the project initial expectation and updates well communicated to all those involved. A company deploying lean should also have the right organisational structure and adequate supporting infrastructure. Finally, it is

important that small wins are celebrated always. People should know what has been done and what was achieved. It sends a message and motivates those involved.

Researcher: What has been the outcome?

ENIC TMS: Although there was little challenge starting because of time constraints for the facilitators who had to combine their official duty with their new role of lean project facilitation, today we are better off as everything is falling in place. We have recorded successes in our output. We have improved some processes, we now have adequate checks in areas where there were initial loop holes, time have been saved in some projects, spaced have optimized in other areas, improved planning and better scheduling has occurred in other areas while people morale received a boost in other areas. All this have occurred within a year of this deployment and surely we will get better as we have only just started.

Researcher: What have been the challenges?

ENIC TMS: The challenges have been normal challenges to do with everyday life in this country (Nigeria). So basically our main challenge is external. Internally, the continuous improvement culture is gradually being built and we are getting there.

Researcher: Thank you for your time.

6.2.4.2 Interview with the ENIC Senior staff (ENIC SS)

Researcher: Is this organisation practicing lean?

ENIC SS: Yes. The process improvement philosophy has just been introduced.

Researcher: How did the company come about this philosophy?

ENIC SS: It came from the global management and we keyed in just about a year ago.

Researcher: Can you describe how lean was deployed in this organisation?

ENIC SS: We knew for sure that it was a top management decision and they showed commitment to it. The next thing was workshops and group discussions being organised to create awareness on the benefits of lean. Then departments sent a list of areas where they think need improvement, they choose their facilitators from their group or allied groups and these appointed facilitators had two weeks intensive training on how to deploy and facilitate the continuous improvement process. They knew what was expected of them before they started. The time frame was there for them and their progress was constantly being monitored by a coordinating officer appointed by the top management.

Researcher: How has the system been thriving?

ENIC SS: The deployment has been driving with great management support, mentoring, relevant expert intervention when necessary and the peoples drive to succeed.

Researcher: What do you think has been the enablers?

ENIC SS: Personally, I think it is the visible management commitment and support, adequate supporting infrastructure, already existing workable processes and finally but most importantly the people. They are the processes owners and their processes can only improve if they show commitment and work at improving it.

Researcher: What has been the outcome?

ENIC SS: Better, faster and safer processes with a winning people.

Researcher: What would you regard as the challenges?

ENIC SS: Apart from the external challenges which everybody knows in this country, the other challenge is the facilitators and teams being able to effectively manage their Lean project time with their everyday job. It is actually becoming easier because they have been able to fuss it into their everyday job processes and schedules.

Researcher: Thank you for your time.

The analysis of this interview and other interviews (using the same questions) at other organizations used for the action research can be found in chapter seven. Questionnaire developed in chapter three were also administered in all the organisations used in the action research. The analysis of the response from the questionnaire administered can be found in chapter eight.

6.3 THE ACTION RESEARCH AT ILMM (INDUSTRIAL LAUNDRY MACHINE MANUFACTURING)

The researcher was invited to ILMM as the company decided to implement lean in a bid to improve its work flow in its job floor area and to reduce the cycle time for production. From the researcher's first contact, communication and the current state value stream observations, it was obvious that there were a lot of waste in the form of Waiting, Inventory, Excessive Motion, Defects and Rework. Waiting and Inventory accounted for 830 minutes waste for non-value adding activities. There was the problem of waiting for parts from the suppliers and sometimes the suppliers supply wrong parts after all the time wasted on ordering the parts and waiting for the delivery, more time would then be spent waiting for the right delivery. There was also the challenge of employees waiting for a process to finish before they could do their part of the Job. There was also the problem of excess motion both of the workers and the parts being process. All these observations negate the fundamental tenets of Lean which simply expect that processes are performed with

minimum non value added activities in order to reduce all unnecessary delays accruing from queuing time, waiting time and moving time from excessive motion or unnecessary transportation (Pattanaik and Sharma, 2009; Wong, Wong and Ali, 2009).

6.3.1 SSM Expressing the Problem Situation at ILMM

From general interactions and visual observations, it was clear that the problem situation included; excess inventory, unorganised store, excessive waste of time in carrying out checks to certify materials and parts to use and poor work area layout. The problem situation is expressed in a Rich Picture as shown in Figure 27.

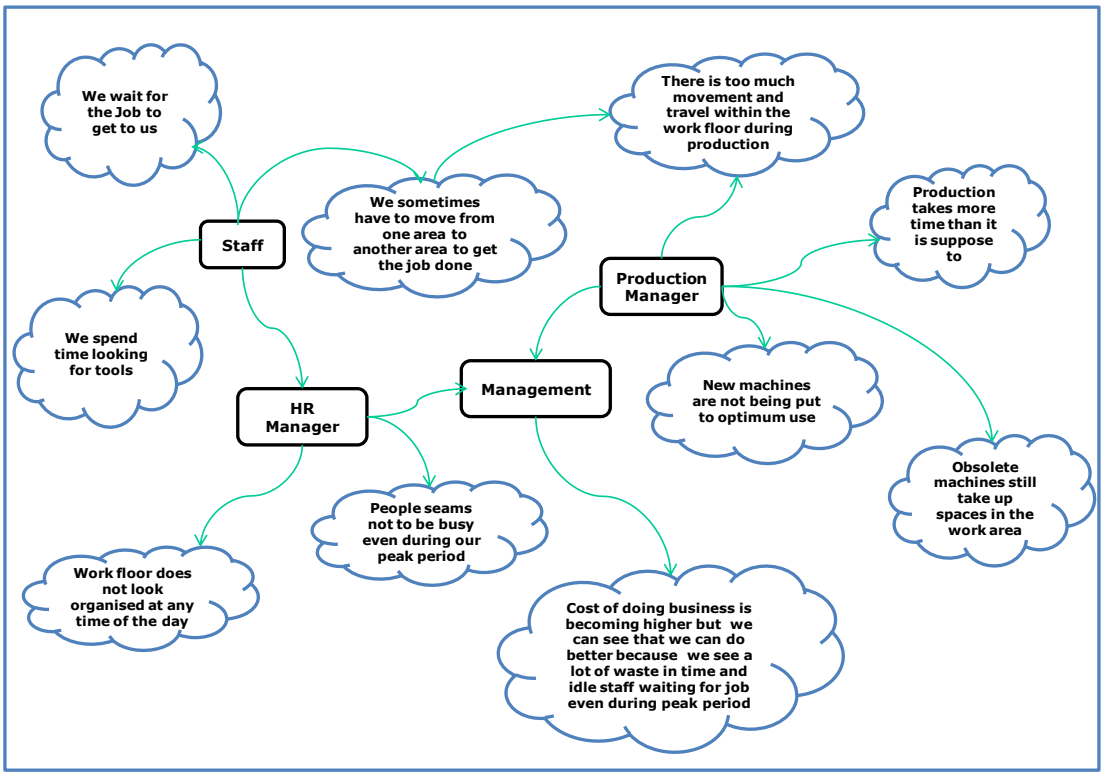

Figure 27: Soft Systems Rich Picture for Initial State in ILMM

6.3.2 ILMM SSM Root Definition of Problem (Stage 3)

The 'root definition' of the problem can be expressed as 'An Industrial Laundry Machine Manufacturing Company with an unorganised production process and work area seeking to be more efficient in its production of Laundry Machines for both Local and International Market'. Using the CATWOE mnemonic the Customer are the Beneficiary of the going concern is the company, the market and the community where the workers are from. The Main Actors are the Staff, Management, Health and Hospitality Sector/Institutions. Transformation process is the need for the organisation to evolve and organised, orderly and efficient process of production to fulfil the goal of the `company. Weltanschauung is the world view of the expectation which is a well organised process with motivated, multi-skilled and cross trained workers are essential for sustainable efficient production system. The Owners are those that can stop the transformation are the company and their major stakeholders. The Environmental constraint is the market dynamics of demand.

6.3.3 ILMM SSM Building a Conceptual Model Stage 4

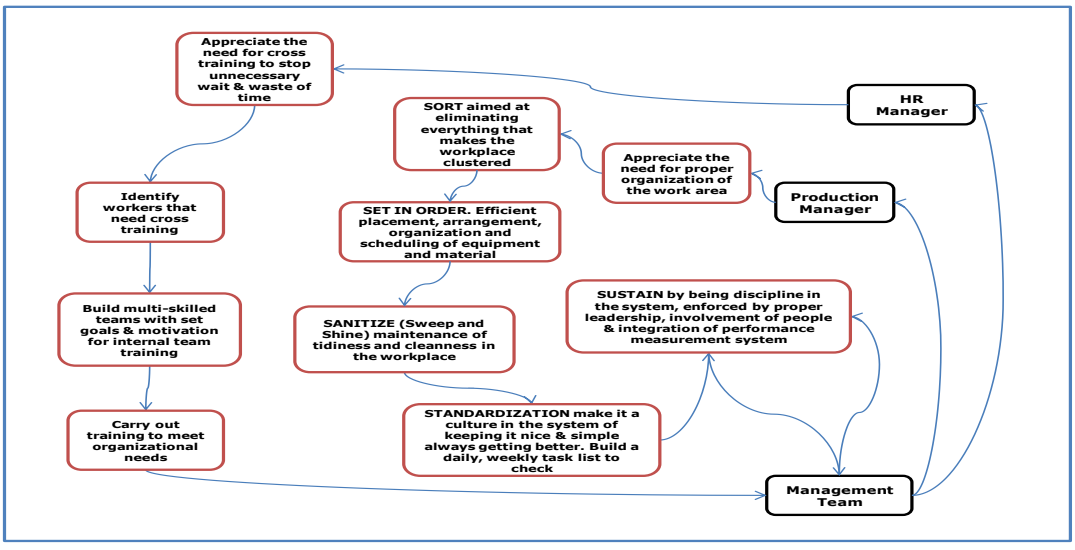

Figure 28: The SSM Conceptual Model for ILMM

A conceptual model is the human activity model that conforms to a possible improvement with visible goal which is achievable with the interaction of the actors within the wider system. Figure 28 shows the Conceptual Model for ILMM improvement process.

6.3.4 ILMM SSM Comparing the Model with the real world Stage 5

Comparing the proposed conceptual model with what is actually feasible, it was seen to be achievable if there was management commitment and if the aim of the proposed Lean implementation activities are properly communicated to the staff through planned strategic orientation. The planned strategic orientation on the Lean philosophy for all staff must be seen as a principle that would direct and influence the activities of the organisation and generate the behaviours intended to ensure its effective implementation and sustenance (Hakala, 2011). The Intended cross training for the staff was also feasible because the trainers were to be sourced from within and motivational incentives created to enable the system have multi-skilled functional teams to carry out the day to day production activities.

6.3.5 ILMM SSM Changes Desirable and feasible made to improve the real situation Stage 6 & 7

The management team showed commitment on the Lean implementation as members of the top management were always there to participate in, observe or encourage each Lean implementation activities. As part of the improvement, it was decided that 5S Lean tool with a track record of success (Sweeny, 2003; Cox, 2002) be used to arrange and tag the frequently used tools, visually displaying them and putting them within reach to reduce motion. With the knowledge that an efficient layout configuration saves time (Soriano-Meier et al., 2011), a more efficient layout that will encourage better flow in the process, saving lost time due to excessive internal movement was proposed and was immediately implemented together with the 5S. Using 5S, Sorting of the existing inventory in the store

was done. What was needed as buffers and critical spares were separated from those items that where occupying space and tying down capital. The store area was then cleaned and a smaller area allocated for storage using the new layout. The Machining areas for Turning, Milling, Cutting, Boring, Tapping and Grinding were all Set in Order according to flow with the various areas cleaned up with regularly used tools kept within reach by visually displaying it with tags at the area of use. A monthly audit for each area would hence forth be carried out with the set standards for the ideal in order to sustain what has been achieved. According to Hayes and Wheelwright, “well-run factories around the world share many similarities; they are clean and orderly, emphasizing quality and dependability” (Hayes and Wheelwright, 1984). As we clean, set in order, standardise and attempt to sustain, we move each step up the way towards a well-run factory, a factory that is truly lean, “with tools that ensures the reduction in operational cost through the reduction of waste” (Zakuan & Mat Saman, 2009).

Kanban philosophy was also introduced into the production process, through the use of signals and cards, making it a pull system instead of the push system thus allowing the customers and the market to determine what is being produced. The Pacemaker (a function or process that set the pace of the whole value stream so that the work process will flow at a constant rate by simply levelling the scheduling (Maskell and Baggaley, 2004)) dictates the scheduling of production while the better flow allowed by the improved layout allows for easy information flow which could be termed a visual control. Cross training of employees and more technical training which the lean implementation has ensured had caused a reduction in the problem of defects or rework. Now we have more quality work being done and produced without the need of quality inspectors. Also the company introduced

suppliers feedback and encourage the suppliers involvement in the process and this action got the delivery time reduced from over two weeks to just a week. The improvement on the production process has also resulted in the reduction of the production cycle time from 277 hours to 144 hours (92.36% improvement) in two months.

Gains of the improvement also showed that the warehouse which had excess inventory in the initial state was eliminated with the supermarket pull system introduced in the improved state allowing the refill of materials only on demand from the suppliers. This on-demand pull system from the suppliers also serves as the additional control procedures and associated inspection which the suppliers carry out as a self monitoring tool on the working time and total operational activities (Nooramin, et al., 2011). This also eliminated the quality control checking process at the warehouse in the initial state. Without a warehouse, the quality control checks were now being done from source as the suppliers must meet the quality specification in their supplies. Kanban cards were introduced as signals at the paint shop and assembly to help in balancing out the flow of work at both points. This eliminated the waste of 282 mins of inventory waiting before the paint shop and assembly in the initial state. The information flow was also streamlined and easier as the processes were now reduced with the pull system determining the flow of materials and parts in the process.

6.3.6 ILMM Lean Implementation: Interview on the Lean Philosophy Deployment

After the deployment of Lean the organisation was visited three times within six months by the researcher and the improvement team. During these visits, a total of one month observation was carried out. Interview was conducted with the Managing Director (here referred to as ILMM TMS) and the Engineering Manager (referred to as ILMM SS).

6.3.6.1 Interview with the Managing Director (ILMM TMS)

Researcher: Is this company lean?

ILMM TMS: Two years ago, I would not have understood the meaning of your question but thanks to the engineering manager who introduced us to the lean philosophy. To answer your question, I would say this company is going lean. It might look slow now but we will surely get there.

Researcher: How did the deployment start?

ILMM TMS: It started with the engineering manager introducing lean to the top management team. We accepted it a decided to implement it in or system. We did an orientation workshop for all staff to create awareness about the process and its expected benefits. We then had to sort out our processes and everything we had as inventory. We also looked at our store, what we had as scraps and the general floor layout. We had to set the work floor area in order, clean the place and develop a standard work plan and practice that was more safe and efficient with less scrap and waste. We also had to build our quality control and assurance into the process as everybody is now responsible for quality rather than the original practice of have people specifically assigned as quality control or quality assurance officers. The process is now in full swing.

Researcher: How has the system been thriving?

ILMM TMS: Lean has been thriving because we in the management team is fully in support and the people are learning how to make their processes better and faster without waste in our quest of always satisfying our customers.

Researcher: What have been the enablers?

ILMM TMS: We have created an environment that would make lean work. Our people are well trained and competent in what they do. They work in teams and so are always cross trained within the team. In our industry we have the best paid staffs, so they are motivated to work, give their best and improve as the day go by. We have the best equipments in the business in this country. So, I would say we have adequate supporting infrastructure for lean to thrive. The engineering manager who is more like the lean deployment mentor is there for everyone who needs help or have improvement suggestions. All this and many more which you must have seen can be termed enablers.

Researcher: What has been the outcome?

ILMM TMS: It has been a success story thus far. Some of the outcomes include; a better, more efficient and safer work layout. Waste from defective production of parts has reduced drastically and the most important benefit thus far is the reduction of our process lead time from 277 hours to 144 hours.

Researcher: What have been the challenges?

ILMM TMS: The major challenge thus far was when we wanted to reorganise the work layout which had some fixed structures. We had the option of removing the structure or designing the new layout around it. It was quite challenging but we opted for the option of designing the new layout around the fixed structure. The engineers welcomed the idea and saw to it that everything was structurally stable and that the design showed the necessary improvement needed. Other challenges include managing the supply chain and coming to terms with the existing international market.

Researcher: Thank you for the time spent.

6.3.6.2 Interview with the ILMM Engineering Manager (ILMM SS)

Researcher: Is this company lean?

ILMM SS: That is where we are going. We are going lean. We have started and we will get there.

Researcher: What do you mean?

ILMM SS: It was my advice to the company and the top management in September 2009 and they saw reasons with me. The leadership is committed to its vision of optimization by eliminating all forms of system and process waste. We have started by carrying out awareness programs, conducting workshops, designing and implementing a new process layout and reducing our inventory. So we have started and the continuous improvement process will continue.

Researcher: How has the new thinking been thriving?

ILMM SS: The people have been the key. Without the support of the people we would not be where we are in less than nine months. Lean as a learning process has made us better. We are stronger as a team are learning from each other to improve our processes at lesser cost and within shorter period. So we are doing better and we will only get better by our continuous improvement philosophy.

Researcher: What have been the enablers?

ILMM SS: The leadership support has been great. It has helped the deployment. The people acceptance of the philosophy was also key to the little success recorded thus far. We have a

thriving company with all the necessary tools and equipment so I would say the leadership and the people has been the key enablers.

Researcher: What has been the outcome?

ILMM SS: We have had an extra 280 minutes in our production value added time buy cutting waste. We have reduced our process lead time from 277 hours to 144 hours which you have seen. We are continually developing our people and building strong internal and external teams. We have also created a mechanism were we could get more feedback from our customers, staffs and suppliers. The outcome would be more as we continue on this part of continuous improvement.

Researcher: What have been the Challenges?

ILMM SS: The challenge has been in getting suppliers that will always be available with the necessary supplies at the right price when needed. We are trying to build a long term relationship with our present suppliers. This has been our major challenge but we gradually getting better and faster response from them.

Researcher: Thank you for giving your time for this interview.

6.4 THE ACTION RESEARCH AT SCT GOVERNMENT AGENCY

At SCT the researcher was invited to participate by way of educating and creating awareness on the benefits of the implementation of lean in a government parastatal being supervised by a lean professional. The researchers participated in the supervising officer's effort in improving the way the Parastatal was being run. The challenge was basically to have an organised system that would make existing policies work. From observation and inquiry

there were also issues of attitude to work and accountability. The problem situation from observation and inquiry is expressed in Figure 29.

6.4.1 SCT SSM Expressing the Problem Situation

The problem situation is expressed in a rich picture in Figure 29. The rich picture shows the current situation and systems challenges within the organisation.

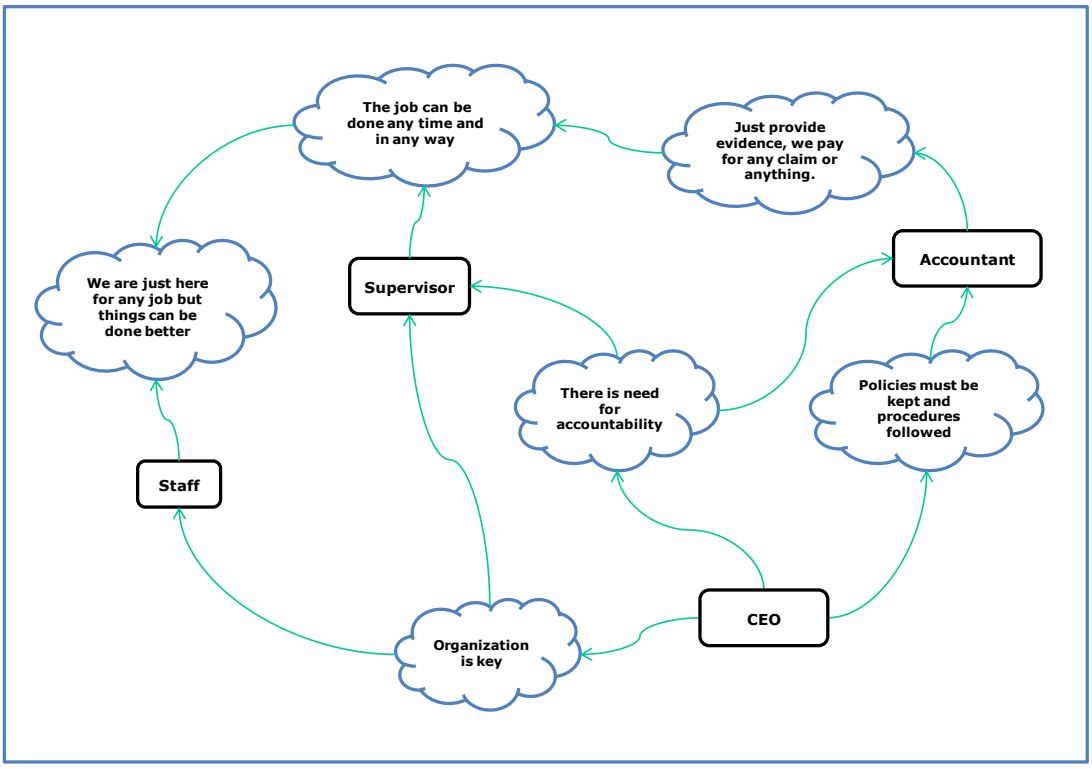

Figure 29. Soft Systems Rich Picture for the Initial State in SCT

6.4.2 SCT SSM Root Definition of the Problem

Putting the various perspective illustrated in the rich picture into consideration in formulating the root definitions of the relevant systems using Peter Checkland's CATWOE mnemonic we have;

- Customers = the people, the government.

- Actors = the staff, the management.
- Transformation = Unorganised system where anything goes is replace by a system that is organised and accountable.
- Weltanschauung = The People want a better, organized and accountable work place.
- Owner = the government.
- Environment = ineffective organisational structure.

The relevant system defined from its root is 'a government owned parastatal being organized to be efficient, effective and accountable'.

6.4.3 SCT SSM Building a Conceptual Model

The root definition of the relevant systems led to the building of a conceptual model as illustrated in Figure 30.

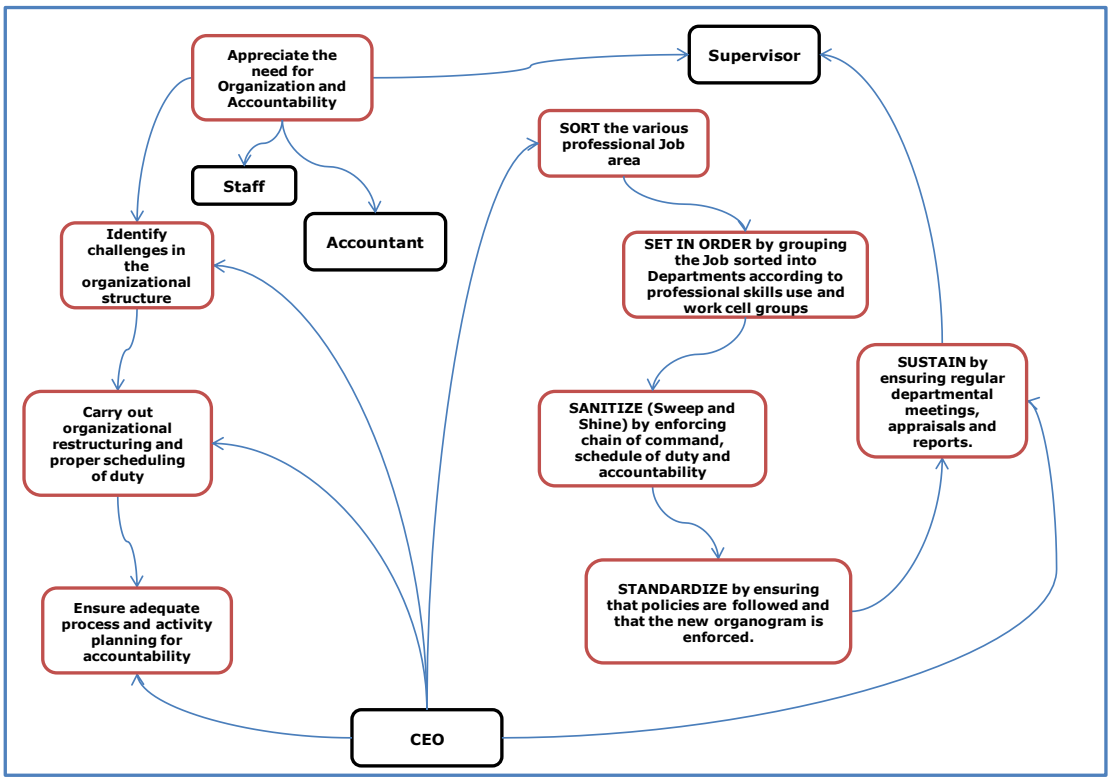

Figure 30: Soft Systems Conceptual Model for SCT

6.4.4 SCT SSM Comparison of the model and the real world, effecting suiting changes and implementation

Comparing the model with what could be obtainable in the real world, the change sort in the model is feasible. These changes include carrying out a workable organisational restructuring for accountability and enforcing existing policies. The action taking was a restructuring of existing department structure to allow for work process efficiency and accountability. Regular departmental meetings, reports and appraisal were also enforced. These made the organization a more organised and accountable system and work friendly environment where majority of the staff were happier and proud to work in as everyone now knew what was expected of them and whom to report to. This soft benefit resulted in 90% reduction in staff lateness and 98% reduction in absenteeism in three months. The general facilities maintenance cost was also reduced by 40%.

6.4.5 SCT Government Agency Lean Implementation: Interview on the Lean Philosophy Deployment

In the course of the active participative action research, it was observed that the CEO of SCT Government Agency was the driving force in the lean deployment at the organisation. During the participative field study, actions were taken in restructuring of existing departments to allow for work process efficiency and accountability. The restructuring saw the existing nine departments (Admin/Finance, Design, Research Development, Mechanical and Materials, Electrical and Subsystems, Quality, Legal, Auditing and Procurement) realigned into four major departments of Admin and Finance, Mechanical Engineering and Manufacturing, Electrical Engineering and the Research Development and Strategic Project Management Department. Regular meetings and reports were also enforced to encourage a regular open forum for suggestions and creation of continuous improvement ideas. External and internal cross training was also being encouraged while staff warfare which included the

compulsory annual leaves enforcement, general staff bus for staff transportation use and a subsidised staff canteen was also introduced. These all added to employees' morale boost which most staff were happy of and also talked about. This resulted in a soft benefit that showed a 90% reduction in staff lateness and a 98% reduction in absenteeism in three months. Processes and procedures were put in order and the system was open and became clearer for all stakeholders. The accounting and cost management system was also computerized with control measures fixed and these reduced the general facilities maintenance cost by 40% in three months.

In the course of the idiographic field research and observation at SCT Government Agency, two interviews were conducted with a top management staff (TMS) and a supervisory staff (SS).

6.4.5.1 Interview with the SCT Top management staff (SCT TMS)

Researcher: Is your company practicing the lean philosophy?

SCT TMS: Yes we are. It is simply doing the right thing at the right time and doing it right the first time to achieve the right results with minimum effort using the available resource.

Researcher: How did the Company come about this philosophical practice?

SCT TMS: I will say it was my idea but I had to get the buy in of my staff through one to one discussions, departmental meetings and get-together. As the CEO of this Agency it is my responsibility to see that things work efficiently and effectively. It was also a cost benefit issue for me. I saw lean as the philosophy of choice because it ensures the optimisation of available resources by ensuring that necessary activities are carried out and the needs met

just-in-time. Although this required restructuring and change management, we did it and it is working.

Researcher: How did you do it?

SCT TMS: I was appointed in February 2010 as the CEO of this Agency. I came in, did my study of the system and new there was a need for some change in the philosophy of how things were being done in the system. There was need for organisational, structural and system discipline to allow for action and activity traceability and just-in-time performance. Originally everything within the system was almost directly the responsibility of the CEO as we had nine officers reporting directly to me. The officers included Admin/Finance, Design, Research Development, Mechanical and Materials, Electrical and Subsystems, Quality, Legal, Auditing and Procurement. I saw the need for delegation of duty and restructuring. In July 2010 we started by having four heads of Departments reporting directly to me. All the initial nine reporting lines were restructured to the four which included; Admin and Finance, Mechanical Engineering and Manufacturing, Electrical Engineering and Research Development and Strategic Project Management. This created some clear duties and responsibility that empowered all officers from top to bottom. The culture of regular sections and departmental meetings was introduced. There was also a general quarterly meeting. All units were to submit weekly reports to their departments, while the various divisions had to send in monthly reports. This allowed for continued action and activity traceability.

The next step was aligning staff to areas, sections and departments were they were most competent by their qualifications and experience. In house trainings were also conducted which external training were supported and encouraged. There was also the need for

efficient and effective process alignment. The various processes and procedures were looked at by the process owners. They were undated and made available for all to see. Most notably was on maintenance, finance and staff welfare.

The staff appraisals were not regular. Now a yearly appraisal system has been developed. As part of staff welfare we have provided a staff bus and a subsidised staff canteen. Staffs were also encouraged to make full use of their annual leave to get refreshed as a sound mind would result in better output. Most importantly, my office is open to any staff with new ideas of how to get things done better. We now have workable intranet and internet facility for easy communication and for ideas generation. Whatever better way 'you think or know' just let us know. It could be the improvement and lift we need. I think their response have been very encouraging.

Maintenance was also a challenge because there was no existing functional method of tracing the state of our facilities. Records were not properly kept. Now a data base has been created for the facilities. This data base can be accessed just-in-time for facility use, repairs and checks.

The finance has also seen some control measures introduced with a data base system created for all inflow and outflow of cash. Final authorisations and approval for any financial transaction or expenses comes from the Director of finance and the CEO's office.

Researcher: What has been the key enabler of this success thus far?

SCT TMS: Our commitment to success has been the key enabler. The people have bought in to the idea. They like the way things work now and they want it to work even better. So the people are also very key to our success story.

Researcher: How would you describe the outcome thus far?

SCT TMS: I would say 'good'. We are not yet there, but we will get there very soon.

Researcher: What have been the challenges?

SCT TMS: Some existing national policy has been very challenging but we are meeting the high expectations from these challenges.

Researcher: Thank you for your time.

6.4.5.2 Interview with the SCT Supervisory Staff (SCT SS)

Researcher: Is this organisation lean?

SCT SS: That is what the CEO has been preaching. All I know is that we are more effective now in the way we do our job. We have also become more efficient as things are done right and on time the first time.

Researcher: How did the organisation come about this?

SCT SS: It was the idea of the CEO and as at today all the directors and majority of the staffs talk about it. I think it is because of the good results we have seen from it thus far.

Researcher: When did this new system start?

SCT SS: It was introduced by the CEO. I think it was in May 2010.

Researcher: Can you describe the new philosophy introduction system adopted by the new CEO?

SCT SS: When he came, we had a general meeting where he was introduced. He addressed us and all he sold in his speech was 'Lean' better and easier way of doing things, with visible

traceability and continuous improvement. He said he would do his best to continuously improve the system, its processes and the people with the ultimate aim of satisfying our customers whom we serve.

He had a one to one chart with most people for a month and had some top management meetings. There was great awareness created on lean and its benefits. The next thing we saw was a restructuring with proper alignments of section with four major departments instead of the initial nine. The good news is that we are all now responsible for the work we report our activities at our weekly meeting and also send monthly official report to our direct supervisors. We would all be appraised by the work we have done and our contribution to the organizations continuous improvement at the end of the year. We also have regular project meetings. This was not the case before.

I think people are now involved in the system. The CEO says we own the system and that is exactly what it is. We think about doing things right the first time and doing it better the next time.

Researcher: How has the system been thriving?

SCT SS: It has been going well. It is the people. They believe in the philosophy, it is part of our DNA now and we are making our processes and output better and better all the time.

Researcher: How do you know it is better?

SCT SS: We can see it. We feel it. The results are there for all to see. Sometimes the improvement is huge and we can all see it. Sometimes the improvement is small but it is also visible as there are standard means of measuring outcome.

Researcher: What have been the challenges?

SCT SS: It is finance. There is so much to be done but with limited finance. The message from the top is 'be innovative'. Do all that needs to be done with what you have. The other challenge is the pace of things. It is moving faster and faster every day. My fear is 'how long will things continue to move better and faster this way'. Where is the limit? Would we be always able to cope?

Researcher: Continuous improvement is continuous. Beyond the sky is the limit and hopefully the system would be able to cope. Thank you for your time.

6.5 THE ACTION RESEARCH AT MET LTD

In MET Ltd, her Lean initiative was geared towards her seasonal production and human resource use management. The available public infrastructure was a challenge as it resulted in increased cost of operation due to private power generation. Its production needs was seasonal and increases during the rainy and harmattan seasons. They had to keep their competent human resources and maintain a stable flow of human resources all year round. The researcher was invited to assist the organization in its deployment of the lean philosophy geared towards maintaining a stable flow of its competent human resources all year round in its challenging seasonal business environment.

The MET Ltd case shows a situation where the unfavourable environmental business conditions meant the organization had to eliminate all forms of waste in its process in order to optimize the available resources to be able to constantly satisfy its customers and all other business stake holders. The problem situation is expressed in a rich picture in Figure 31.

6.5.1 MET SSM Expressing the Problem Situation

The problem situation is expressed in a rich picture in Figure 31. This shows the social-technical pictorial view of the current state of the problem situation in the organisation.

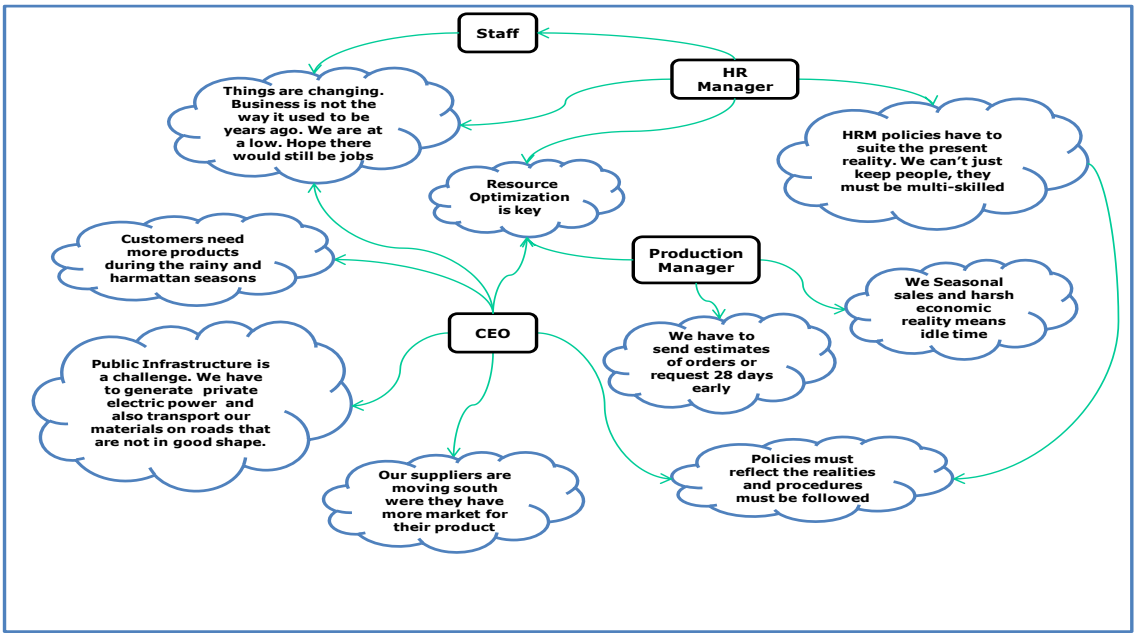

Figure 31: Soft Systems Rich Picture for Initial State in MET Ltd

6.5.2 MET SSM Root Definition of the Problem

From the rich picture various perspectives could be seen. The perspectives mirrored through Checkland's CATWOE define the relevant systems as;

- Customer = The beneficiary from the business operation, it includes those who purchase, use and market the product and every other entity that gain some form of benefit from the business day to day operations.
- Actors = the Staff, the Management and the board of trustees.
- Transformation = Scheduling use and effective management of available resource (human, material and financial resources) to eliminate all forms of waste and ensure optimization that will satisfy customers and guarantee profitability.

- Weltanschauug = unfavourable environmental business condition that has occurred in recent years that has resulted in the rise of the cost of doing business.
- Owner = the company trustees.
- Environment = Poor infrastructures (roads and electric power generation), changing market dynamics as suppliers are being attracted to the south and other government policies that seems to 'look the other way'.

The definition of the relevant system is 'a company optimizing using the lean philosophy to compete favourable in a 'not so encouraging' business environment'. From the root definition of the relevant system a conceptual model is developed (see Figure 32).

6.5.3 MET SSM Building a Conceptual Model

The root definition of the relevant systems led to the building of a conceptual model as illustrated in Figure 32.

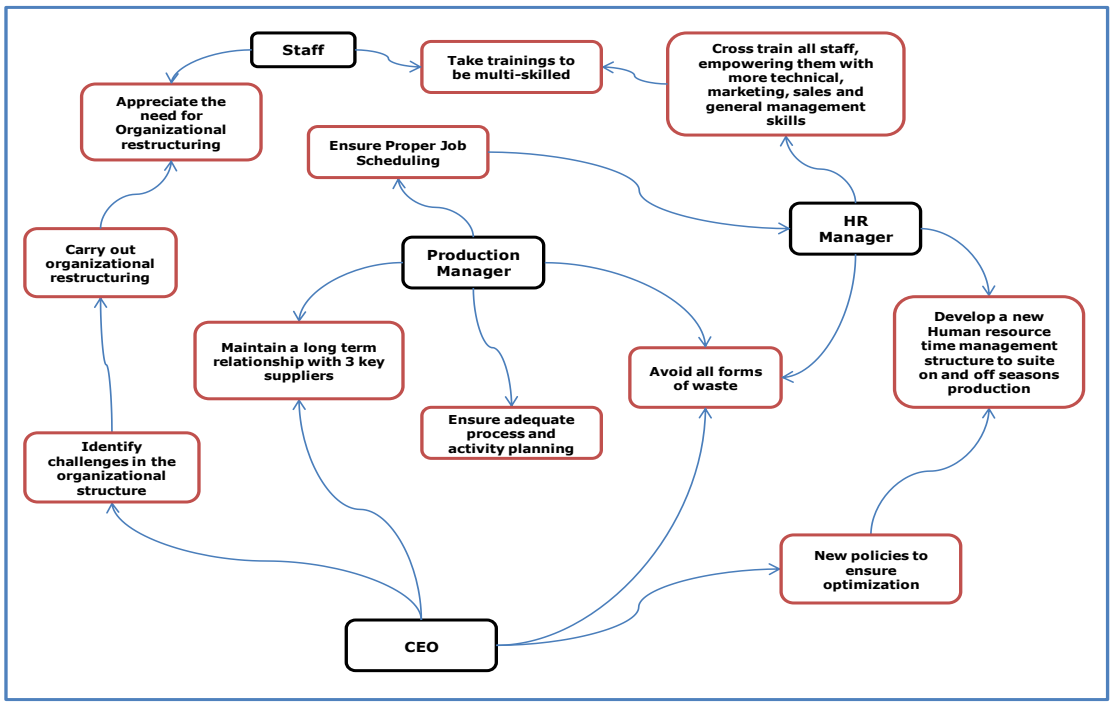

Figure 32: Soft Systems Conceptual Model for MET Ltd

6.5.4 MET SSM Comparison of the model and the real world, effecting suiting changes and implementation

Comparing the conceptual model with the real world, developing a new human resource time management structure is feasible. Cross training all staffs to empower them, make them more job flexible and multi-skilled is also feasible. Restructuring the organisation is a very viable option while building and maintaining a long term relationship with three key suppliers of various raw materials is also visible. The conceptual improvements are possible with management commitment, good coordination and better understanding from the staffs.

The implementation of changes commenced with the cross training of staffs while departments with economically or process overlapping functions were merged. A notable merger is the fusion of the maintenance department into the production department. The maintenance staffs have been trained on production processes and systems so that they can work on the production teams while standing bye for any maintenance function that may arise. Also, proper planning and cost effective scheduling of production are now being carried out to ensure that production is only done during regular work hours. This has led to a reduction in overtime claims and payments resulting in a monthly cost reduction of 10%.

6.5.5 MET Ltd Lean Implementation: Interview on the Lean Philosophy Deployment

At MET Ltd the lean deployment, initiated a human resource management policy adjustment that allowed for a flexible use of its human resources. Staffs had flexible but equal monthly work hours which increases during peak production time and reduces during off seasons. During off season the available staffs alternate or change duties or jobs since the organization's staffs were already crossed trained and so could fit-in in a variety of areas and section within the system. They also maintained a long term relationship with their

major suppliers which helped as it guaranteed some level of Just-in-time supply considering the existing transportation infrastructural challenge. The Organisation had to use the lean philosophy of waste reduction and optimisation to be profitable and stay in the business and that they were doing and continuously finding better ways of doing.

After a two weeks process observation, the researcher conducted two interviews. One was with the Executive Director (here referred to as MET TMS) and the other interview was with the Production Manager (referred to as MET SS).

6.5.5.1 Interview with the MET Ltd Top management staff (MET TMS)

Researcher: Is this company lean?

MET TMS: The Company is Lean. We really do not have a choice than to be lean if we want to compete favourably in our market. The conditions are tough and to compete favourably all forms of waste in material or process must be avoided or totally eliminated if possible.

Researcher: How did the company come about this philosophy?

MET TMS: Like I said, it was circumstances that taught us how to do things better to survive as a company and to continually improve by the day.

Researcher: When did lean deployment start in the company?

MET TMS: It has been the practice for over ten years now in this organisation but nobody called it 'Lean' as a name. I only knew that our philosophy was aligned to Lean about four years ago in the cause of my PhD study. Ever since then we have made effort to continuously improve using lean tools such as 5S, Poka-Yoke and levelling. One of the challenges though is that my people don't want to be using the Japanese terminology so we

do it but in a language that we all understand. We are generally improving our system and we hope to get better.

Researcher: How has the optimisation and continuous improvement philosophy thrived?

MET TMS: Well, the management team has done a lot by ensuring that we have only what we need. We have also planned out our schedule better and have managed our human resources well by allowing for a business seasonal human resource optimisation philosophy that gives us more hands during our peak periods. The staffs have also been cross trained so that any of them can go through the production process completely without any technical challenge. We are still teaching them more business, sales and marketing skills which will be useful for them and for the company too. So, our people and our processes are making us stronger by the day.

Researcher: Would you term them your enablers.

MET TMS: Yes. They are our enablers. Our successes and our philosophy depend on the people and how they constantly execute it for our systems and process continuous improvement. We just provide the necessary leadership and direction.

Researcher: What has been the outcome?

MET TMS: The major outcome is that we have had a manageable system where things works and were staff know that they are responsible for daily production, quality, continuous process improvement and sustenance.

Researcher: What have been the Challenges?

MET TMS: Our major challenge is environmentally related. It cost us more to produce in this country than it would cost us in other countries as we have to generate our own electric power and suffer the uncertainty and unnecessary long wait for our raw materials to arrive because of the condition of the roads. Our suppliers are also moving down South because their market is increasing more down South. The challenge is really enormous but we are working hard and optimising as much as we can and that has kept us this far. Being Lean by ensuring that all forms of system and process waste are minimised or eliminated has actually helped us. We will only continue to improve.

Researcher: Thank you very much for your time.

6.5.5.2 Interview with the MET Ltd Production Manager (MET SS)

Researcher: Is this company lean?

MET SS: It depends on what you mean by lean. All I know is that we are doing the best to achieve the most we can with the available resources and all the time we try to get better by continuously improving even in this harsh economic situation. So if that is what you call lean just like my Executive Director do, then this company is definitely lean.

Researcher: Is this the management philosophy?

MET SS: Yes. It is the management philosophy to improve our processes and increase our output by reducing or eliminating all forms of waste. This practice has been there for years now.

Researcher: Would you say the company has been faithful to the tenets you listed above?

MET SS: Yes we have been faithful to the best of our ability.

Researcher: How do you pass this philosophy on?

MET SS: All new staff gets a week of orientation. At the orientation they are taught the company's philosophies and ideals. They are also shown the benefits of lean and how it has improved the companies system. They are taught to be continuous improvement ambassadors in the company. In this way, we pass it on.

Researcher: What has been the driver of your system of improvement?

MET SS: The people have been the driver of this system. The more competent they are the better the company and the better its future in the long run

Researcher: What has been the outcome of the organisations philosophical practice?

MET SS: So far so good. The quality of our product remains one of the best in Africa and we intend to continuously improve on everything we do.

Researcher: What are the existing challenges?

MET SS: The existing challenges are more of the external social economic situation affecting the companies in the country. The challenge of good roads for the suppliers and the supply of raw materials, the challenge of industrial electric power generation and other issues which are very important for production and general development. It is a general thing in the nation so we do not have to complain. We are just doing the best with what we have.

Researcher: Thank you for your time.

6.6 SUMMARY

This Chapter looks at the active participatory enquiry process of the research that took the researcher to four organisations where the researcher was involved in the deployment of the Lean philosophy using a soft systems methodology. This research showed the dept and insight a combination of investigative exploration and participatory Soft Systems Methodology can give in a social technical study and as in classical Soft Systems Methodology. In all the cases, the research and the lean implementation teams in the various organisations use the available resources within the system to improve their process. The action research also showed the importance of LEADERSHIP commitment in ensuring the lean deployment succeeds. The PEOPLE in each case were the drivers of the various processes. All identified waste were minimised and where possible eliminated from the values stream of each PROCESS. A continuous improvement PROCESS was then instituted as the OUTCOME was continuously being monitored in the quest for perfection.

This chapter also presented the interviews conducted in each of the organisations where the action research was carried out. The next chapter present the analysis of the interviews conducted by the researcher.

CHAPTER 7: INTERVIEW ANALYSIS

7.1 INTRODUCTION

In the course of the action research, semi-structured interviews were conducted after the various deployment of the Lean philosophy at each organisation. Those interviewed were people in the organisation who took active part in the lean deployment. A top management staff and a shop floor supervisory staff were interviewed in each organisation.

The questions asked during the interviews were eight in all. They are

1. Is the Company Lean?
2. How did the company come about this philosophical practice?
3. When did the Lean deployment start?
4. How did the deployment start (What were the initial steps at the beginning of the deployment)?
5. How has the system been thriving?
6. What have been the enablers?
7. What has been the outcome?
8. What have been the challenges?

The interview questions were designed to elicit objective response on what had made the lean deployment a success or a failure in their various organisations from the interviewee's experience. The questions used sort to know;

1. If Lean was actually in practice and its history in the organisation – Questions 1, 2, 3 and 4.

2. What the factors enabling the Lean implementation success or failure in the organisation are – Questions 5 and 6.
3. What the exact outcome in the organisation had been thus far – Question 7.
4. What the challenges are – Question 8.

Sourcing for information from the interview involved listening for 'words' which existing literature has agreed are synonymous with the practice of lean.

7.2 LITERATURE ON WORDS SYNONYMOUS WITH LEAN

Lean as a philosophy and practice have been associated with practices such as JIT, TQM, TPM and HRM (Shah and Ward, 2003). Words such as Leadership, Long term philosophy, Teamwork, Communication, Efficient use of resources, Excellent process flow, Pull system, Quality, Employee empowerment, Culture, Visual Control, Respect for people, Continuous Learning, Continuous improvement and Customer Satisfaction (Liker, 2004; Womack et al., 1990) have also been synonymous with the practice of Lean.

For the action research objective triangulation purpose, the key words that were looked out for in the course of the interview were words that have been proven from existing research to be consistent with the implementation of lean. Such words include Leadership (Achanga et al., 2006; Anand et al., 2009; Appelbaum et al., 1998; Boyer, 1996; Gudmundsson, 2004; Liker, 2004; Puvanasvaran, et al., 2009; Soriano-Meier and Forrester, 2002), People (De Menezes et al., 2010; De Treville and Antonakis, 2006; Liker and Morgan, 2006; Puvanasvaran et al., 2008; Shah and Ward, 2003), Training (Anand et al., 2009; Boyer, 1996; Houshmand and Jamshidnezhad, 2006; Puvanasvaran, et al., 2009), Process (Karlsson and Ahlstrom, 1996; Motwani, 2003; Rother and Shook, 2009; Sanchez and Perez, 2001; Womack and Jones, 1996), Continuous improvement (Ahlstrom, 1998; Karlsson and

Ahlstrom, 1996; Knill, 1999; Sanchez and Perez, 2001; Singh et al., 2006; Womack and Jones, 1996), Empowerment (Blanchard et al., 2001; Boyer, 1996; Olivella, et al., 2008), Expectation (Upadhye et al., 2010a), Competence (Hillgren and Jacobs, 2009), Quality (Pfeifer et al., 2004; Shah and Ward, 2003; Shah and Ward, 2007; Womack et al., 1990), Just-In-Time (Shah and Ward, 2003; Shah and Ward, 2007; Womack et al., 1990), Teams (Boyer, 1996), Communication (Puvanasvaran, et al., 2009; Worley and Doolen, 2006), Supporting Infrastructure (Boyer, 1996), Planning (Monden, 1983; Niepce and Molleman, 1996; Pfeifer et al., 2004; Rother and Shook, 2009), Motivation (Appelbaum et al., 1998; De Treville and Antonakis, 2006; Womack et al., 1990), Culture (Dahlgaard and Dahlgaard-Park) and Outcome (Buyukozkan and Ozturkcan, 2010; Cochrane, 2007; De Treville and Antonakis, 2006; Pedersen and Huniche, 2011; Scherrer-Rathje et al., 2009; Upadhye et al., 2010a).

7.3 ANALYSIS OF THE INTERVIEW

For a proper analysis, the eight interview questions were put into four major question groups which include;

- Deployment: Question 1, 2, 3 and 4 all investigating when and how the company deployed lean.
- Enablers for Sustenance: Question 5 and 6, investigating how Lean has been thriving and what the enablers are.
- Outcome: Question 4. Ascertaining what the outcomes are thus far.
- Challenges: Question 5. Knowing the challenges.

7.3.1 Enabler for Deployment and Sustenance

A summary of the frequency of Key 'Lean' words used by the interviewees during the interviews at the various organisations (see Table 8) showed that words such as PROCESS, PEOPLE and LEADERSHIP were either used directly or inferred to from a phrase or statement relatively more than any other words.

Deployment	STMS	SSS	ETMS	ESS	MTMS	MSS	ITMS	ISS	Total
Process	**8**	**6**	**1**	**1**	**3**	**1**	**4**	**1**	**25**
JIT	2				1				**3**
Empowerment	2	1	1						**4**
Expectation	1		2	1					**4**
Culture	1								**1**
Competence	1				1				**2**
Training	1		3	1	2	1			**8**
Procedure	1								**1**
People	2	4	2		3		2		**13**
Motivation	1								**1**
Idea of Better Outcome	1	1				1	2		**5**
Infrastructure	2		2						**4**
Communication	1	2	2	2			1	1	**9**
Leadership	**1**	**1**	**6**	**5**	**2**	**1**	**3**	**2**	**21**
Continuous Improvement		3	1	2	2	1			**9**
Satisfying Customers		1					1		**2**
5S					1		1		**2**
Poka-Yoke					1				**1**
Levelling					1				**1**
Planning					1				**1**
Teams							1		**1**
Layout							1		**1**
Quality							1		**1**
Enablers for Sustenance									
Leadership Commitment	1	1	1	3	1		1	2	**10**
People	**2**	**1**	**2**	**3**	**1**	**1**	**2**	**4**	**16**
Results (Outcome)	1	4	2	2	1			2	**12**
Process		2	3		1			2	**8**
Competent Staffs			1			1	1		**3**
Supporting Infrastructure			2	2			3	1	**8**
Satisfying Customers			1						**1**
Expectation			1						**1**
Communication			2						**2**
Motivation			1				1		**2**
Trained Staff							2		**2**
Teams							2	1	**3**
Efficient Work floor Layout								1	**1**

Table 8. Summary of the frequency of Key 'Lean' words used by the interviewees during the interview

Where STMS & SSS is for **SCT**, ETMS & ESS is for **ENIC**, MTMS & MSS is for **MET Ltd** and ITMS & ISS is for **ILMM**

The results however showed some inconsistency in their (PROCESS, PEOPLE and LEADERSHIP) use and level of frequency from one interviewee to the other (see Table 8). However they (PROCESS, PEOPLE and LEADERSHIP) were the only 'Lean' words which were mentioned at least once by all the interviewees. COMMUNICATION and RESULT (OUTCOME) were all mentioned by all but two of the interviewee during the interview sections. TRAINING, CONTINUOUS IMPROVEMENT, COMPETENCE/COMPETENT STAFF and SUPPORTING INFRASTRUCTURE were next in the most frequently used 'Lean' words with all but three of the interviewee using the words in the course of interview. An expectation of 'better outcome' was also inferred to in four of the interviews while the 'Lean' words EMPOWERMENT and EXPECTATION were used in three of the interviews. Lean words or phrase such as JIT, SATISFYING CUSTOMERS, 5S, MOTIVATION and TEAMS were used in two of the interviews. Every other Key 'Lean' word was used by just one interviewee in the course of the interview sessions (see Table 8).

7.3.2 Outcome and Challenges

At ENIC, those interviewed (ETMS and ESS) stated that the outcome had shown an improvement in the areas and process where Lean had been deployed. They were now better, faster and safer with increased output at lower cost. Morale of staffs and process owners had also had a boost as they were all involved and also felt a sense of accomplishment in the quest of an improved system. At ENIC, the major challenge was that of the implementation team being able to managing the time for their day to day duty with that of their duty as members of the implementation team.

Those interviewed from ILMM agreed that the deployment of Lean had resulted in a better, safer and more efficient work layout. Their process and final product waste had also been

reduced. They also been able to develop stronger teams and had also improved their relationship with their suppliers. The major challenge faced by ILMM in the course of the Lean implementation was trying to work around already existing fixed structures on their work floor area during the production layout re-design to improve the work flow.

At SCT the staffs interviewed (STMS and SSS) felt better as their process became better and things generally started falling in place. Their challenge was some of the existing government policies which they felt duplicated responsibilities and created room for waste of time and human resources. They also had some already existing financial challenges.

In MET Ltd, the implementation of Lean from the interviewees' opinion created multi-skilled crossed trained staffs and a manageable system where things works and staff knew what their responsibility were in terms of daily production, quality and continuous improvement. The challenges faced in the lean deployment at MET Ltd were more of economical and the decay or lack of the necessary social infrastructure in their business environment (location).

7.4 SUMMARY

This chapter analyses the information generated from the interviews conducted in the course of the action research. The findings from the analysis of these interviews showed that 'The Leadership', 'The People', and 'The Process' are the main elements in the system that makes lean implementation possible and sustainable in any organisation planning to implement or already deploying lean. It also validated the Lean LPPO implementation model and shows the philosophical implementation use of the model in all the cases involved in the action research as they all started with the 'Leadership', then the 'People', then the 'Process' which involved the process owners and then the 'Outcome' which was what was planned for.

This also confirms the near consensus of most Lean practitioners and researchers (Holweg, 2007; Krafcik, 1988; Liker, 2004; Ohno, 1988; Shah and Ward, 2003; Womack et al., 1990) that Leadership, People and a well thought out, planned and executed process which leads to organisational excellence and customer satisfaction are what ensures the successful implementation and sustains Lean philosophy in any organisation that deploys Lean.

These findings from the analysis reinstated the philosophical bases of the Lean LPPO implementation model. It shows that LEADERSHIP, PEOPLE and PROCESS are the main determinant of a successful implementation and sustenance of Lean in any organisation. The next chapter present the analysis of the questionnaire survey conducted in the course of the research.

CHAPTER 8: SURVEY RESULTS AND ANALYSIS

8.1 INTRODUCTION

The research which was carried out by the use of the soft systems methodology was triangulated with semi structured interview and a questionnaire survey. The questionnaire was administered at the four organisational where the participatory action research was carried out and also to three other organisations/groups. This chapter looks at the results from the questionnaire survey which was completed by the seven (7) groups (six (6) organisations and a collection of questionnaires from fifty (50) lean professionals from lean practicing organisations referred to in this work as QREM). The response to the questionnaire from the survey was analysed using the Statistical Package for the Social Science (SPSS). Table 9 gives a breakdown of the number of returned questionnaire from each group/organisation.

Organisation	Size	No. of Staff	Q. Given	Q. Returned
SCT Government Agency	Medium	92	40	12
ENIC (Energy International Company)	V.Large	Over 500	40	40
ILMM (Ind. Laundry Machine Manu.)	Medium	57	40	25
MET Ltd	Medium	288	40	15
RNPC	Medium	91	40	15
PS&D Ltd	Small	45	40	14
QREM	Medium-V.Large	50	50	50
Total			**290**	**171**
Total useable response				**171**

Table 9. Organisation Details and Number of Given and Returned Questionnaire from each group

8.2 SURVEY: AIMS, RESULTS AND ANALYSIS

The aim of deploying the survey was to examine

1. If the commitment shown by the leadership is essential to the outcome in lean implementation
2. If there is a correlation between leadership commitment and motivation in a lean environment
3. If there is a correlation between the organisational culture and the outcome of lean implementation
4. If a free interactive organisational culture correlates with staff motivation in a lean environment
5. If the quality of the human resource (level of skill and experience) in an organisation correlates with the level of outcome in lean implementation
6. If there is a correlation between workers empowerment and process excellence in a lean environment
7. If the motivation of staff in a lean environment correlates with the level of empowerment
8. If there is a correlation between 'the ability and competence level' of the staffs and a successful outcome in lean
9. If the motivation of staffs correlates with their ability and competence in a lean environment

The questionnaire administered had questions distinctly grouped on Motives for implementation, Leadership, Influencing factor in implementation, Target area, Challenges to implementation, Organisational culture, Empowerment, Ability and Competence,

Motivation, Process, Outcome and Feedback (Bou-Llusar et al., 2009; Boyer, 1996; Peng et al., 2008; Samson and Terziovski, 1999; Shah and Ward, 2007). The questions in each group were designed specifically to measure and assess the group title variable as it relates to the adoption of lean principles. The respondents rated their answers on a five-point Likert scale with scores ranging from 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree) to 5 (strongly agree). See Chapter three for a sample of the questions used and appendix 1 for sample of the questionnaire administered.

Cronbach's coefficient Alpha was used to assess inter-item reliability. The useable Alpha (Leadership, Organisational culture, Empowerment, Ability and Competence, Motivation, Process, Outcome and Feedback) indicates acceptable inter-item reliabilities of 0.70 or above for established scales (Coakes, 2005; Morgan et al., 2004) see table 10.

Variable	Mean	Std. Deviation	# of Items	Cronbach's Alpha
Leadership	3.9839	0.62641	8	0.894
Organisational Culture	3.7175	0.66060	10	0.923
Empowerment	3.5913	0.70280	9	0.908
Ability & Competence	3.8485	0.53152	10	0.853
Motivation	3.8544	0.67964	10	0.915
Process	3.7024	0.45793	26	0.926
Outcome & Feedback	3.7692	0.57497	13	0.911

Table 10. Descriptive statistics and reliability analysis of the items (questions) in each question grouping in the questionnaire

The statistical questions from the aim of deploying the survey are;

1. Does the commitment shown by the leadership correlates with the outcome in lean implementation?

2. Is there a correlation between leadership commitment and motivation in a lean environment?
3. Is there a correlation between the organisational culture and the outcome of lean implementation?
4. Is there a correlation between organisational culture and staff motivation in a lean environment?
5. Does the quality of the human resource (Ability and Competence) in an organisation correlate with the level of outcome in lean implementation?
6. Is there a correlation between workers empowerment and process excellence in a lean environment?
7. Does motivation of staff correlate with their level of empowerment?
8. Does motivation of staff correlate with their ability and competence in a lean environment?

Table 11 shows the inter correlation of the variables.

	(N = 171)	1	2	3	4	5	6	7
1	Tlead	1.00						
2	Torgcul	0.63	1.00					
3	Tempow	0.65	0.78	1.00				
4	Tability	0.59	0.69	0.72	1.00			
5	Tmotivat	0.53	0.69	0.68	0.56	1.00		
6	Tprocess	0.48	0.61	0.66	0.64	0.59	1.00	
7	Toutcom	0.59	0.67	0.68	0.74	0.55	0.68	1.00

Correlation is significant at p< 0.01 level (2-tailed).

Table 11 Inter-Correlations of the variables

Where,

- Tlead = Totalleadership = Leadership commitment
- Torgcul = Totalorgculture = Organisational culture
- Tempow = Totalempowerment = Empowerment
- Tability = Totalability = Ability and Competence (Human Resource Quality)
- Tmotivat = Totalmotivation = Motivation
- Tprocess = Totalprocess = Process Excellence
- Toutcom = Totaloutcome = Outcome

The results from the Correlation table show that;

1. There is a significant positive relationship between the level of leadership commitment shown and the outcome in lean implementation, $r = .59$, $p<0.0001$.
2. The level of leadership commitment shown also significantly correlates positively with the level motivation shown by the staff in a lean environment, $r = .53$, $p<0.0001$.
3. There is also a significant positive relationship between the organisational culture and the success level in terms of outcome from lean implementation, $r = .67$, $p<0.0001$
4. There is a significant positive relationship between organisational culture and the level of staff motivation in a lean environment, $r = .69$, $p<0.0001$.
5. There is a significant positive relationship between the quality of the human resource (Ability and Competence) in an organization and the success level in terms of outcome from lean implementation, $r = .74$, $p<0.0001$.
6. There is also a significant positive relationship between the level of workers empowerment and the level of excellence in the processes in a lean environment, $r = .66$, $p<0.0001$.

7. The level of staff motivation significantly correlates positively with their level of empowerment, $r = .68$, $p<0.0001$.
8. There is a significant positive relationship between the level of motivation shown by staffs and their ability and level of competence in a lean environment, $r = .56$, $p<0.0001$.

All the results points to the fact that Leadership commitment, empowered, competent and motivated people in a lean environment will result in improved processes and positive outcome from lean implementation.

A graphic view of the mean plot of the respondents from each of the seven groups (see Figures 33, 34, 35, 36, 37, 38 and 39) on each variable (Leadership, Organisational Culture, Empowerment, Ability & Competence, Motivation, Process, Outcome & Feedback) show that ENIC (Energy International Company) and QREM group leads the pack in their lean practice from the opinion of their staff from the questionnaires returned. The mean values of their scores from the questionnaires are higher as the comparative harmonic mean plot on the graphical Figures 33, 34, 35, 36, 37, 38 and 39 shows. Statistically, these plots do not give a factual comparative representation due to noise factor that would have resulted from unequal group sizes. Having higher values that tend to show better performance on the plot could be a coincidence because if twelve points are randomly selected from each group and plotted together again, they may show equality or may even vary inversely from what is presently shown in Figure 33, 34, 35, 36, 37, 38 and 39.

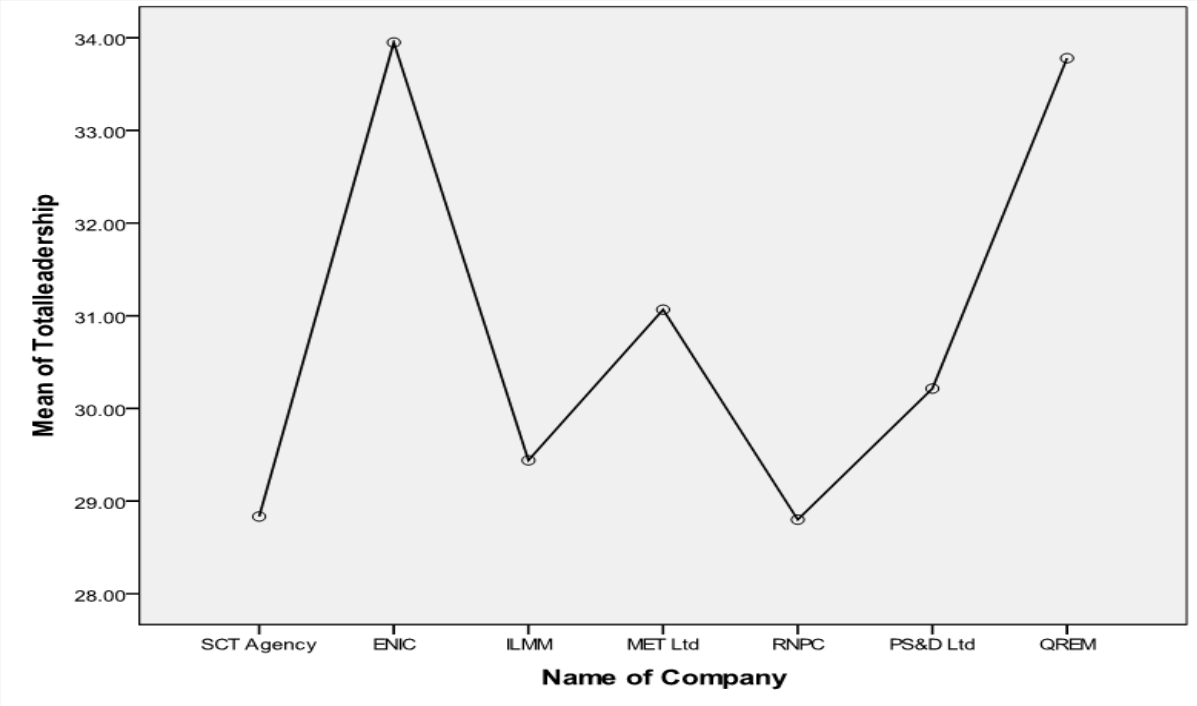

Figure 33. Comparative Harmonic mean plot of the 7 company/groups for Leadership

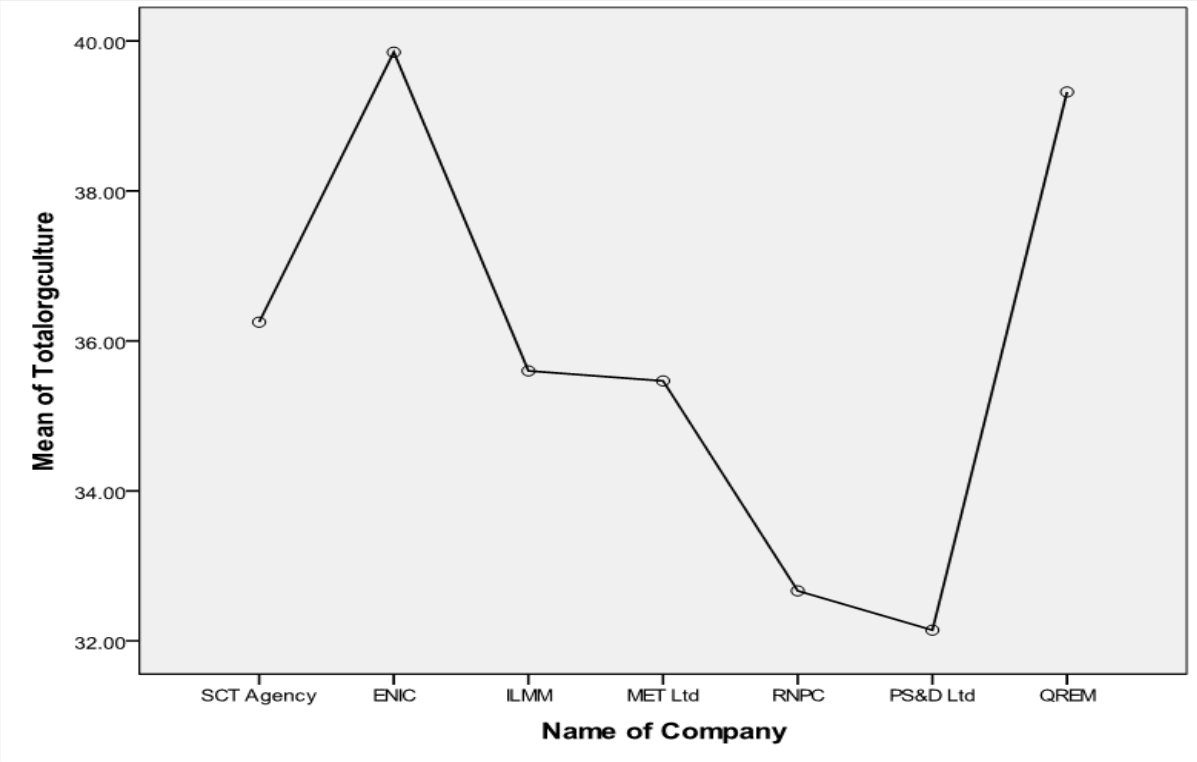

Figure 34. Comparative Harmonic mean plot of the 7 company/groups for Organizational culture

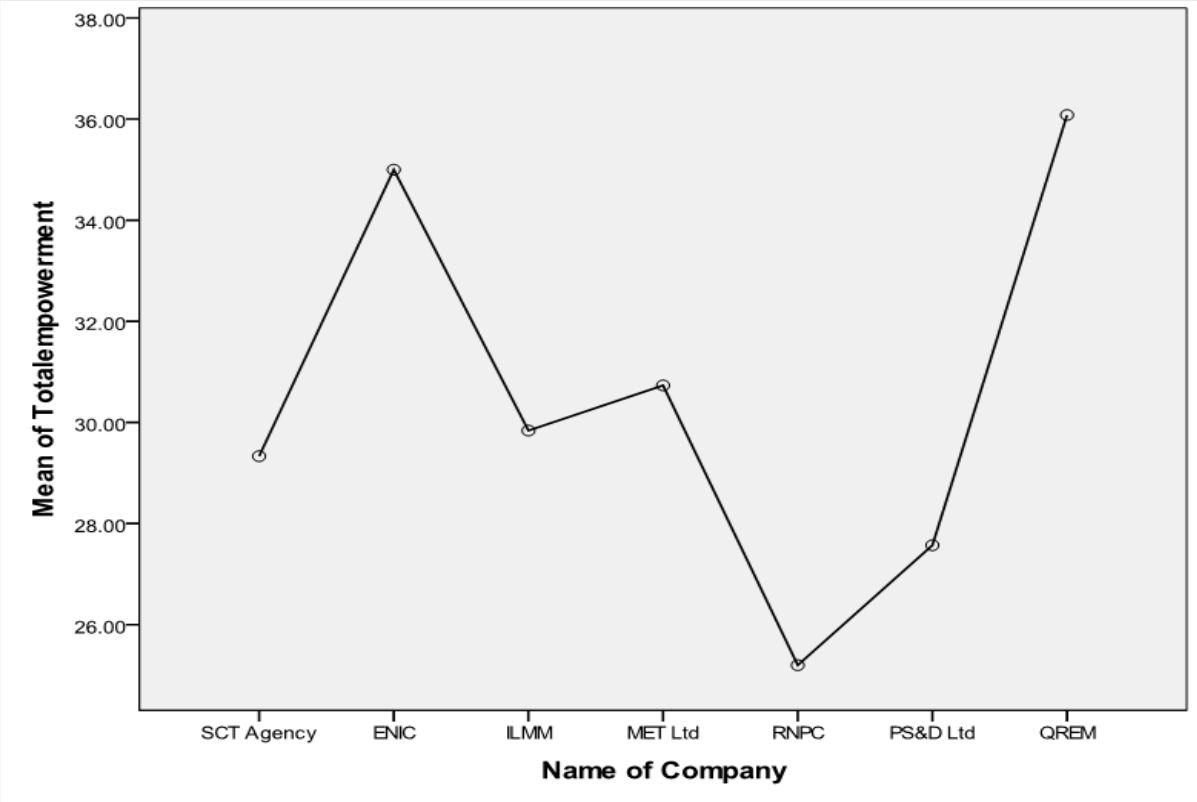

Figure 35. Comparative Harmonic mean plot of the 7 company/groups for Empowerment

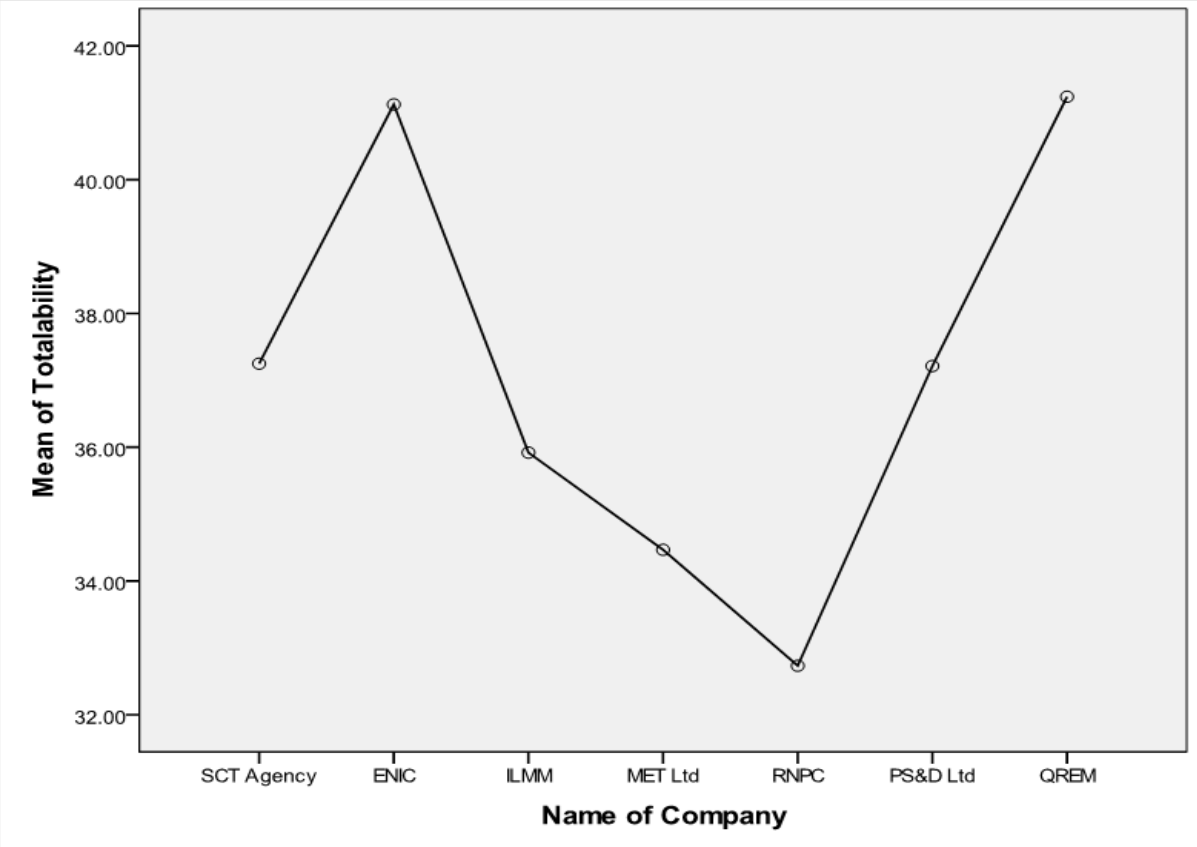

Figure 36. Comparative Harmonic mean plot of the 7 company/groups for Ability & Competence

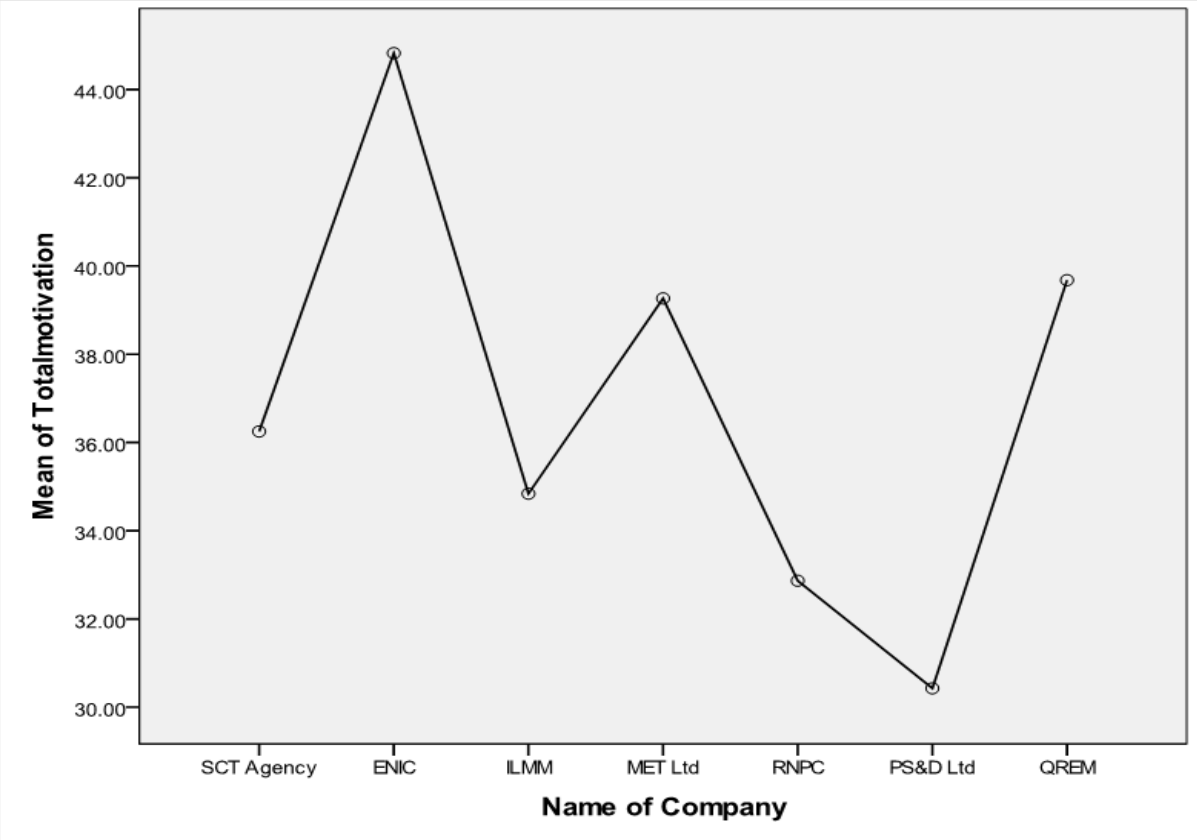

Figure 37. Comparative Harmonic mean plot of the 7 company/group for Motivation

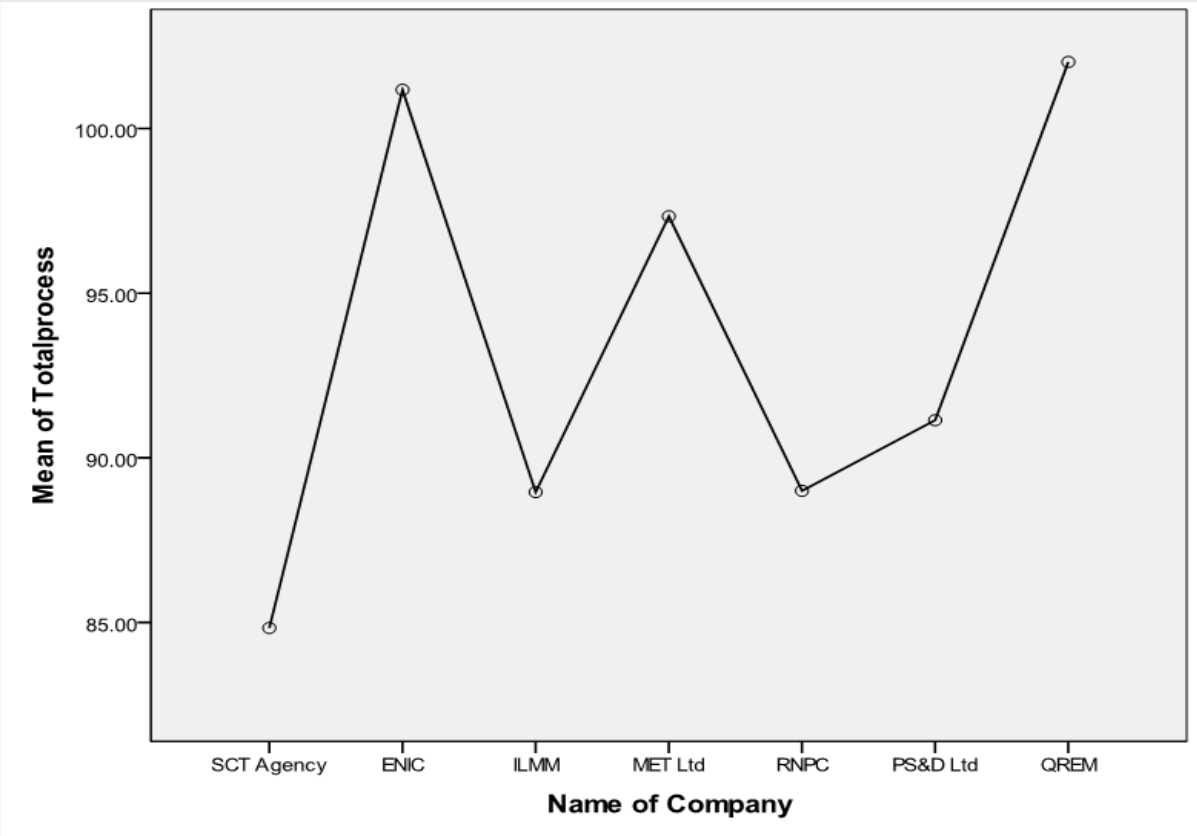

Figure 38. Comparative Harmonic mean plot of the 7 company/group for Process Excellence

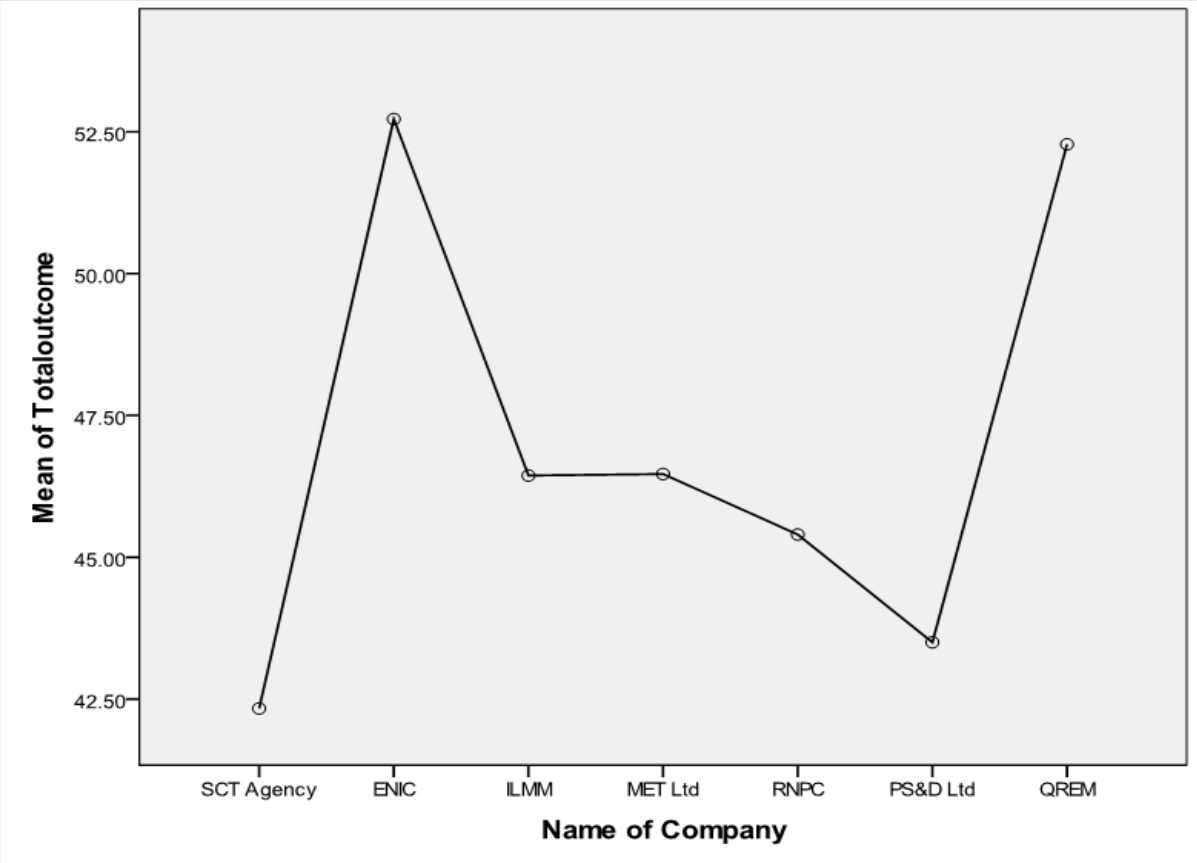

Figure 39. Comparative Harmonic mean plot of the 7 company/group for Outcome & Feedback

8.3 SUMMARY

This chapter shows the survey result and uses SPSS to analyse the results obtained from the questionnaire survey. The results from the survey analysis show that LEADERSHIP commitment, PEOPLE empowerment, competence and motivation are essential to the implementation and sustenance of Lean in any organization. Positive OUTCOME from the continuous improving PROCESS which Lean institutes also helps in sustaining the philosophy where ever it is implemented. The next chapter discusses the findings from this research.

CHAPTER 9: DISCUSSION

9.1. INTRODUCTION

From its first use by Krafcik (1988) in his MIT International vehicle Program research finding titled 'Triumph of Lean Production System', the word 'Lean' has been used by various scholars and business managers to mean various optimisation approach and attempt at different times and in different situations. Lean is contextual, it is relative. It is a contextual optimisation and process waste elimination dialectics which is relative as it depends on time and place. It is an active continuous learning process of getting better in what we do with the same resources. It is achieving more with the same resource by doing better and not allowing waste. Lean is a subjective construct for a continually improving cycle of effective and efficient optimisation of available resources which is dependent on the Human Resource. The use of the word 'LEAN' is subjective because any other word may have previously been used in the past, still being used today or could have been constructed and used to mean the same thing with similar philosophy at different time, in different era and in different environment within various diverse culture.

Lean as a subjective term in connotations and industrial/academic dialectic meaning can be seen in its use as synonyms for TPS (Toyota Production System), JIT (Just-In-Time), CI (Continuous Improvement), JPM (Japanese Production Management) and even for QMS (Quality Management System) in terms of practice, ethics, processes, expectation, results and performance (Holweg, 2007; Schonberger, 2007; Shah & Ward, 2007; Shah & Ward, 2003; Monden, 1983; Hall, 1983a; Schonberger, 1982a). Lean is an optimised process that creates value which meets the customer's need at the least cost with little or no waste. It is the constant quest for the elimination of this waste in the process that creates a movement

towards process perfection through continuous improvement. In reality, implementing Lean can be described as being agile within the confines of the business environment and the available resources of an organisation. Agility from this lean perspective is "the successful exploration of competitive bases (speed, flexibility, innovation proactivity, quality and profitability) through the integration of reconfigurable resources and best practices in knowledge-rich environment to provide products and services in a fast changing market environment" (Yusuf et al., 1999). This was exemplified in the four cases involved in the action research as they all deployed lean as a means of meeting their operational and business needs through the integration of reconfigurable resources and best practices within the confines of their business environment at a lower cost and in a continuously improving process. A lot is achievable through lean as expressed in the improvements resulting from the use of the lean philosophy that has been reported around the world and Zimmer (2000) in his paper titled 'Get lean to boost profits' gave a list of possible areas of improvement and the level of improvement that may occur from the implementation of lean (see Table 12).

IMPROVEMENT AREA	IMPROVEMENT LEVEL
Delivery lead time	75%
On time delivery	99%
Reduction in defects per year	20%
Inventory reduction	75%
Return on assets	100%
Utilization of Direct Labour	10% or more
Utilization of Indirect Labour	50%
Machine availability	95%
Machine setup time reduction	80 – 90%
Reduction in Cycle time	60%
Quality improvement	50%
Increase in current capacity	50% or more
Reduction in floor space	80%
Productivity (sales/employee per year)	15 – 35%

Table 12. Improvement by implementing the Lean Philosophy (Zimmer, 2000)

Whatever industry, whatever business, be it production or services, this improvements as listed by Zimmer (2000) are bound to gradually occur as the continuous improvement philosophy is sustained. The action research at the various organisations used in this Lean implementation research also recorded some improvements.

9.2 ENIC CASE

The implementation of Lean in ENIC case showed the importance of leadership. The Leadership ensured that the Lean philosophy was deployed at two levels: strategic and operational. The operational improvement activities were in three areas;

- Optimisation of offshore vessels,
- Creation of store space from existing space,
- Meeting up with the organisations Crane Preventive Maintenance Schedule

The deployment of Lean at ENIC (Energy International Company) was a strategic decision taken by the Top Management. There was a vision with a long term commitment to the Lean institutionalisation of the Lean philosophy in the Company. There was real, total and committed leadership. Continuous awareness was created in the organisation. The necessary infrastructures were provided. The people were trained. The training included the use of the various Lean tools for improvement for both shop floor staffs and managers. Lean project were identified and project Champions chosen from 'the process owners' who were from the department where each project domiciles. Each Lean project was facilitated by a knowledgeable and competent professional. There were also interventions from the Lean project teams' coordinator whenever the situation demanded. The results showed a gradual success rate in the Lean process improvement activities. A summary of the 'before' and 'after' improvement activity for the three projects is given in Tables 13, 14 and 15.

Project	Deciding Factor	Before Lean Implementation	After Implementation
Optimisation of offshore vessels	Leadership	They had a long term vision of what they wanted. They were committed and showed respect to their people by involving them in the process improvement activities.	The leadership was still interested in continuous improvement.
	People	They were very competent. They saw the challenge and were will to make things better.	The people were impressed with their improved process.
	Process	Activities were as usual but required improvement due to increasing cost and regular break down of vessels.	Better vessels route planning
	Outcome	High cost of leasing vessels, high cost of maintenance, regular breakdown of vessels, slower and practically redundant vessels.	Efficient fleet management, fewer vessel breakdowns and a cost saving of $1.2 million.

Table 13. Summary of improvement on offshore vessels project

Project	Deciding Factor	Before Lean Implementation	After Implementation
Creation of store space	Leadership	Had a long term vision and were committed to Lean implementation.	Still interested in process improvement.
	People	They were very competent and willing for things to be better.	They were motivated to do more.
	Process	Was the regular inventory management style.	The use of 5S improved the inventory management system.
	Outcome	• Many obsolete items in store, • Unused items and many critical spares kept in store for years. • The store completely filled to capacity.	• Obsolete items were disposed off, • The store became better arranged, well organized and clean after the use of 5S. • Store inventory reduced by 25%,

		• Storage space for the chemical was created which resulted in a cost saving of $61 million.

Table 14. Summary of improvement on store space project

Project	Deciding Factor	Before Lean Implementation	After Implementation
Crane Maintenance	Leadership	Committed to improvement	Committed to further improvement
	People	Felt they were understaffed and so needed more hands.	Had a morale boost and felt they could do it.
	Process	• Crane maintenance jobs were prioritized, • There was regular break-ins in the weekly Job schedule, • Teams were always sent out for job in pairs.	With the immediate approval of the maintenance superintendent needed for critical priority checks, two steps and three hand offs were eliminated and this reduce the process time .
	Outcome	• Schedule compliance was 43.75% • PM Compliance was 45.00%, • Work order on the wrong priority code (illegal work order) was 38.10%	• Schedule compliance became 85.71% , • PM compliance became 85.71%, • Work order on the wrong priority code became 33.33%

Table 15. Summary of improvement on crane maintenance project

9.3 ILMM CASE

In ILLM, they had a fully trained Lean implementation specialist as the production manager. He had a stake in the company and so, leading the Lean deployment process was to the mutual benefit of all. There was a total leadership commitment and a consultant assisted in the deployment. Orientation programmes were initially organised for the entire staff to create awareness and get their buy-in. The improvement recorded can be seen in Table 16.

Deciding Factor	Before Lean Implementation	After Implementation
Leadership	The Leadership was committed to the vision of the business.	The leadership wanted more improvement.
People	The people kept the statuesque	They were trained and given a new orientation to always look out for areas and opportunity for continuous improvement which became the norm
Process	The production layout allowed for excessive movement which results in process waste.	The improved production layout allowed for a better work pull system within the shop floor area.
Outcome	The production lead time was 277 hours	The production lead became 144 hours.

Table 16. Summary of improvement at ILMM

9.4 SCT GOVERNMENT AGENCY

The success recorded in the Lean implementation programme at SCT government agency was due to the commitment of the organisation's leadership which helped to ease the challenges of government bureaucracy. The restructuring of the organisation allowed for work process efficiency and accountability. Things were done better than before and the attitude to work of the staffs improved and the facilities maintenance cost reduced by 40%.

9.5 MET LTD

The MET Ltd case showed the challenges that were from a seasonal and business environment perspective. The implementation of lean brought about internal and external training for the human resource to make them multi-skilled and allow for proper work and labour cost management. In the long run this allowed for proper human resource management and production scheduling that ensured that production was only done during regular work hours which led to a monthly operations cost reduction of 10%.

9.6 THE LEAN LPPO MODEL

All the cases in the action research showed the importance of Leadership in the implementation of Lean. The Lean LPPO Model (see Figure 6 Chapter 4) developed in the course of this research and philosophically tested during the action research was developed due to the none-existence of a philosophical mind model for the implementation of lean, a model that could come to mind any time the implementation of lean is thought about, a model that sequentially directs on the initial elements and chains of activity needed to accomplish the task of instituting Lean.

The Lean Leadership, People, Process and Outcome implementation model as presented on Figure 6 Chapter 4 is conceptual and is based on the people (the Human Resources) as the driving force within any organisation. Various researches have argued that the failure or success of any continuous improvement change process is dependent on the central role played by the people in the process (Armenakis, et al., 1993; Choi, 2011; George and Jones, 2001; Greenhalgh et al., 2004; Hall and Hord, 1987; Isabella, 1990; Lau and Woodman, 1995). Therefore, a successful lean implementation programme should be developed with committed leadership and the people as its fulcrum. A leadership with long term commitment on the lean philosophy and a strategic vision for the organisation is highly essential. This leadership (Top Management) commitment must be seen and be communicated down to all levels of the organisational structure. This Top down communication of commitment drives the people to implement Lean within their processes. The people must be competent; they should be empowered by the Leadership so that whatever improvement ideas they are meant to implement they can implement and immediately start observing the changes and improvement due from the Lean

Implementation. Effective and efficient leadership in Lean must be in a form that is able to cope with collective endeavour, where individuals can contribute to the organisation in its pursuit of a common vision and goal (Thorpe et al., 2011). This form of leadership empowers the people. Empowerment will breed a high degree of organisation commitment at a level where members identify with the goals and values of the organisation and equate the promotion and success of the organisations' interest with their own interest (Taylor et al., 2010). The people are able to communicate and plan their activity; they are also able to walk the process, identifying the value adding and none value adding activities using value stream mapping or any other tool. The 'people' finding are measured, improvement made and performance analyzed while Outcome is expected to be satisfactory to the customers (the people).

The Lean Leadership, People, Process, Outcome 'LPPO' as a model, agrees with Boyer's 1996 assertion. The 'LPPO' model takes it further by insisting on committed leadership with a vision and a long term philosophy which ensure that all supporting infrastructures are in place with well trained, competent human resource driving a successful and continuous improving process. Karlssons and Ahlstrom (1996) lean operational model emphasizes the need for good information flow within the process and encourages the use of multifunctional teams as well as suppliers' involvement in the production processes and in planning. The 'LPPO' model put information in action by effective communication and also empowers the multifunctional teams to continuously deliver safer, better, faster and cheaper output to its customers. This buttresses Sanchez and Perez (2001) submission from their lean production model that the continuous improvement effort should be a constant activity of the multifunctional team after the elimination of existing waste (Sanchez and

Perez, 2001). The LPPO model provides a detailed directional approach to lean implementation. The direction and sequence of action for lean implementation provided in the LPPO model starts with Leadership commitment, high level of consistency in having the right competent, empowered and well motivated people with the right process to produce and sustain the desired outcome. It is an improvement on existing models (Karlsson and Ahlstrm, 1996; Boyer, 1996; Sanchez and Perez, 2001; Houshmand and Jamshidnezhad, 2006). It is a flexible and process friendly model that can be used anywhere and can be adopted in any industry when implementing lean.

9.7 THE METHODOLOGY

The methodology adopted for this research is the Soft Systems Methodology in Triangulation. The Soft Systems Methodology in Triangulation used provoked the investigation of subjective issues such as the process improvement in Lean in relationship to employee competence and motivation. It recognizes the human interactions within the process in all the cases in this research. This recognition and analysis of the human interaction with the process is the strength of the Soft Systems Methodology (SSM).

SSM reveals the complexity and possible ambiguity within an organisation on its path towards achieving a philosophical lean environment. Its use and method of approach in its quest for continuous improvement, creates “an awareness of multiple perspectives (Soderlund, 2011)” that provides contrasting explanations for existing situations. These contrasting and diverse views enrich the understanding of the organisational complexity, ambiguity and paradox (Karatas-Ozkan and Murphy, 2010).

The Triangulation of the Soft Systems Methodology using interviews and quantitative data from questionnaire survey created objectivity in the findings as the convergence of multiple

views allow for greater accuracy in objectivity. This methodology based on systems thinking framework is ideal for this research as most scholars have described lean as a complete system that welds the activities of everyone from top management to line workers, to suppliers, into a tightly integrated whole that can respond almost instantly to resource fluctuation and market demand from customers. As a system philosophy, Lean should be approached from a systems view such as the Soft Systems in Triangulation which captures a more complete, holistic, and contextual portrayal of the various units under study. This methodology allows for further validation and generalizing after objectively eliminating the contextual constrains (Jick, 1984). This research methodology is most suitable for any organization research framework.

9.8 THE SURVEY RESULTS DISCUSSED

The questionnaire survey which included two more organisations and a unique group of 50 lean practicing experts tagged 'QREM' had a total of 171 returned useable responses. All six organisations (SCT, ENIC, ILMM, MET Ltd, RNPC and PS&D Ltd) were given 40 questionnaires each but only ENIC had all the questionnaires completed and returned (see Table 9 Chapter 8). 25 was completed and returned from ILMM, 15 each from MET Ltd and RNPC, 14 from PS&D Ltd and 12 from SCT. This could be related to the fact that ENIC is a very large multinational company where most of the staffs are more educated, better paid and probably more comfortable. Other organisations were in the small and medium size enterprise (SMEs) category.

The 171 response were analysed using SPSS. The results showed that there is a significant positive relationship between the level of leadership commitment shown and the outcome in lean implementation, $r = .59$, $p<0.0001$. This result agrees with Achanga, Shehab, Roy and

Nelder (2006) view that Leadership is the most critical success factor in the implementation of Lean. It permeates vision and strong strategy which encourages and facilitates the integration of all infrastructure and people within the organisation for the successful implementation of lean. Courageous and decisive leadership will inspire an organisation to greater heights (Appelbaum et al., 1998). Leadership commitment to Lean also leads to investment in supporting infrastructure (Soriano-Meier and Forrester, 2002) and the availability of this supporting infrastructure directly motivates the staffs. These staffs in turn continuously churn out satisfactory outcome for the customers and other stakeholders in the organization.

Secondly, the results shows that the level of leadership commitment shown also significantly correlates positively with the level motivation shown by the staff in a lean environment, $r = .53$, $p<0.0001$. This agrees with Swink and Hegarty (1998) assertion that real motivation is the ability to impel employees to high levels of efforts and effectiveness. Leadership commitment to the cause as can be seen from this result motivates the employees to higher levels of efforts and effectiveness in a Lean environment (Peng et al., 2008).

Thirdly, the result from the survey analysis shows that there is a significant positive relationship between the organisational culture and the success level in terms of outcome from lean implementation, $r = .67$, $p<0.0001$. This agrees with Liker (2008) opinion that the organisational culture is the heart and soul of the Lean way. A culture of continuous learning for continuous improvement is the heart and soul of the Lean way. When organisations fail in their attempt to implement lean, the actual challenge for these organisations, lie in their culture (Liker, 2008). When an organisation's culture is such that allow for the continuous

development of its people (employees) to be able to effectively do the necessary core value-added task, add value to the system and their technical abilities, such (constantly learning and developing) organisation is said to be truly Lean. These ability of the employees to effectively do the necessary core value-added task that satisfies the customer creates intrinsic motivation for these employees and this agrees with the results from the survey analysis that there is a significant positive relationship between organisational culture and the level of staff motivation in a lean environment, $r = .69$, $p<0.0001$.

Again the result shows that there is a significant positive relationship between the quality of the human resource (Ability and Competence) in an organisation and the success level in terms of outcome from lean implementation, $r = .74$, $p<0.0001$. This is true because 'you cannot give what you do not have'. Simply put 'the quality of outcome in terms of output from a system depends on the quality of the human resources'. If the available human resources in a system are not competent to perform the job they are employed to do, then the outcome will surely be poor. Liker (2008) describe the value adding steps in creating a lean organisation as those process that lead to quality people producing high quality, low-cost, and on-time products and services. To accomplish this Liker (2008) argues that value-added steps are;

1. Attracting people with the right characteristics who are trainable and can contribute to the value-adding processes,
2. Developing these people so that they have the capability to do quality work every day,
3. Engaging the people so that they go beyond doing the work to improving how the work is done through rigorous problem solving,

4. Inspiring the people so that they are committed to the organisation and will continue to learn, grow, and do their best for the customer, community, and society.

These Liker's (2008) assertions agree totally with the results from the survey that shows that there is a significant positive relationship between the quality of the human resource (Ability and Competence) in an organisation and the success level in terms of outcome from lean implementation, $r = .74$, $p<0.0001$.

The results from the survey analysis also shows that there is a significant positive relationship between the level of workers empowerment and the level of excellence in the processes in a lean environment, $r = .66$, $p<0.0001$. When workers are empowered as it is the custom in Lean practice, they are given the responsibility to improve the system and they learn in the cause of improving the process. This empowerment increases the ability to continuously increase and apply process knowledge to increase the level of process excellence in the environment. This agrees with the results from the survey.

Also, the survey results established the fact that the level of staff motivation significantly correlates positively with their level of empowerment, $r = .68$, $p<0.0001$. This is true because workers tend to be motivated by the increased level of responsibility and control of the organisation's processes which the philosophy of Lean process empowerment gives to its people (Boyer, 1996).

Finally, the survey results revealed that there is a significant positive relationship between the level of motivation shown by staffs and their ability and level of competence in a lean environment, $r = .56$, $p<0.0001$. This is in agreement with Boyer (1996) findings that workers motivation level increases due to their feeling of increase competency level in the

performance of their job as a result of the increased levels of training (a continuous learning practice in a Lean organisation) to build the skill needed to effectively exercise increased responsibility.

All the results points to the fact that a positive outcome from a lean implementation process is one that entrenches the Lean culture of visible Leadership commitment, empowerment of a competent and motivated people in an organisation for the ultimate goal of satisfying the customer, adding value to the existing processes and meeting the needs of all the stakeholders at the list cost and without any process or resource waste.

9.9 THE INTERVIEW AND OBSERVATIONS FROM ACTION RESEARCH

The interview provided a forum for interaction with major stakeholders and process owners on what they could objectively say about the impact of the Lean implementation on their system. The response though a little diverse from position of view, there was a convergence in opinion that LEADERSHIP, PEOPLE, PROCESS and OUTCOME are the most important elements in the implementation and sustenance of the culture of continuous improvement and benefits of Lean in an organisation. The observations during the action research in the four organisations also confirm these assertions. Although there have been stories of bottom-up Lean implementation or deployment process, the fact remains that having the buy in of the top management is key to a successful implementation and sustenance.

If the top management lead the implementation process and are committed to it with a long term vision, the achievement will be as good as, and even better than some of the successful outcome achieved in the action research cases in Chapter 6.

9.10 LEAN FROM THE NIGERIAN PERSPECTIVE

A lot has been written on Lean from various countries but this work is one of the few recorded lean research from the Nigerian perspective. Existing literatures from the body of knowledge show that works on Lean has been written about countries such as Australia (Furlan et al., 2011; Power and Sohal, 2000; Sohal and Egglestone, 1994), Bangladesh (Farhana and Amir, 2009), Belgium (Mothersell et al., 2008), Brazil (Saurin and Ferreira, 2009), Canada (Scott et al., 2009), China (Brown and O'Rourke, 2007), Demark (Christiansen et al., 2003; Pedersen and Huniche, 2011), Finland (Furlan et al., 2011), France (Oliver et al., 1996), Germany (Benders and van Bijsterveld, 2000; Furlan et al., 2011; Oliver et al., 1996), India (Jadhav and Khire, 2007; Kodali, 2003; Kumar and Garg, 2002; Garg et al., 2003; Upadhye et al., 2010b), Italy (Abdel-Maksoud et al., 2010; Furlan et al., 2011; Oliver et al., 1996), Japan (Furlan et al., 2011; Katayama and Bennett, 1996; Oliver et al., 1996; Schonberger, 2007), Korea (Lansbury et al., 2004), Malaysia (Puvanasvaran, et al., 2009), Mexico (Wu and Walker, 2006), Netherland (Heuvel et al., 2006) Romania (Vais et al., 2006), Singapore (Zhou et al., 2009), South Africa (Kojima and Kaplinsky, 2004) South Korea (Furlan et al., 2011), Spain (Furlan et al., 2011; Sanchez and Perez, 2004), Sweden (Ahlstrom, 2004; Furlan et al., 2011; Johansson and Abrahamsson, 2009; Toni and Tonicha, 1996; Zhou et al., 2009), Thailand (Laohavichien et al., 2011; Rahman et al., 2010; Shibata, 2008), UK (Gibbons, 2006; McAdam et al., 2008; Middleton et al., 2007; Oliver et al., 1996; Oliver and Wilkinson, 1992; Parry and Turner, 2006; Wood, 2008), and USA (Apte and Goh, 2004; Balakrishnam et al., 1996; Burnt, 2000; Furlan et al., 2011; Nakamura et al., 1998; Oliver and Wilkinson, 1992; Pickrell et al., 2005; Spear, 2004; Womack et al., 1990; Womack and Jones, 2005). However, there is no readily available documented evidence on Lean implementation or its practice in Nigeria. This research work gives a practical insight from three organisations in

Nigeria using ideographic action study, interviews and questionnaire survey in a soft systems methodology triangulated mix.

Nigeria is the most populous black African country. With a population of about 155 Million people (CIA, 2010). It is located on the west coast of Africa. Its Administrative capital is Abuja while the industrial and business hub is Lagos located in the western part of the country by the Atlantic Ocean. A country whose major source of income was Agriculture in the 60s and 70s, with the dreams of being industrial based in the 70s and 80s, today it economy depends on Crude oil for over 80% of its income being one of the top producers of crude oil in the world.

Although there is scarcely any available documented record of Lean practice in Nigerian, the Lean philosophy has been there and today Agencies, Service Organisations, Production companies and most importantly the Energy sector which includes the Oil and Gas industry in Nigeria practice Lean. The researcher's enquiry on Lean in Nigeria actively involved three organisations (referred to as) SCT Government Agency, ENIC (Energy International Company) and MET Ltd (these organisations are referred to in pseudo names for confidentiality reasons but all description of organisations' background and activities within the organisations remains accurate). A brief background of the Nigerian organisations is given in Table 17.

Organization	Brief Background
SCT Government Agency	A government agency for research and development based in central Nigeria
ENIC (Energy International Company)	A multinational energy company with operations in the western and Niger Delta region of Nigeria
MET Ltd	A pharmaceutical company based in Northern Nigeria

Table 17. Profile of the Nigerian Organisations

Other Nigerian organisations involved in only the Lean questionnaire survey in this research are RNPC a production and mechanical assembly company located in the Northern part of Nigeria and PS&D Ltd a chemical distributing firm based in Northern Nigeria.

9.2 SUMMARY

In this Chapter a discussion of the research activities, methodology and findings was carried out. The Lean philosophy and its benefits are also discussed in brief. Findings from the ideographic action research at ENIC, ILMM, SCT Government Agency and MET Ltd were discussed and the findings showed the immense importance of the Leadership commitment and the competency level of the people (workforce) within each organisation to the successful implementation of Lean and the benefits that result from this successful implementation. It also shows the ease of use and the directional strength of the Leadership, People, Process and Outcome (LPPO) Model for Lean implementation.

The survey result discussed also shows that Leadership commitment, organisational culture, people (staff) competence, workers empowerment and staff motivation are all significantly positively related to the level of successful outcome derived from the implementation of Lean.

CHAPTER 10: CONCLUSION

10.1 INTRODUCTION

The implementation of lean in any system harbours a lot of challenges. “Doing it right the first time” makes the implementation process truly lean as it saves the organization from “waste” of time, effort and other resources. Using the soft systems methodology creates a better view of the “real world” in the organisation. It creates an insight into where the constraints are and so gives a clearer picture of what need to be done. An adoption of the LEADERSHIP PEOPLE PROCESS OUTPUT (LPPO) model (see Figure 6 in Chapter 4) for the lean implementation using the soft systems methodology creates an even better advantage as can be seen from the cases in the action research where the LEADERSHIP and the PEOPLE were always the driving force for all the lean implementation cases.

The observations and outcome of the action research showed the importance of competent, empowered and motivated people and a committed Leadership in the successful implementation of lean. The results from the survey showed that organizational culture is a crucial factor in determining success in Lean implementation. The survey results showed that the level of staffs competence, empowerment and motivation significantly correlates positively with the level of success in terms of outcome. It also showed that there is a significant positive relationship between the level of leadership commitment shown and the outcome in lean implementation, $r = .59$, $p<0.0001$. These results from the survey support the two main mantra of LEADERSHIP and PEOPLE on which the Lean LPPO implementation model is built.

10.2 THE LEAN LPPO IMPLEMENTATION MODEL

The Lean LPPO implementation model developed (see Figure 6 in Chapter 4) in this research is visually directional as it shows the important elements required for a successful lean deployment and these elements are visually portrayed in the order (LEADERSHIP – PEOPLE - PROCESS – OTCOME) which they should be followed and worked at in any organisation that intends to implement lean and sustain Lean and its benefits in their organisation. The Lean LPPO implementation model is also a flexible model that can be used from one industry to another due to its cross industrial adoptable framework. The action research is also a testimony of this, as the model was the main philosophy of implementation of Lean in the case studies used in the action research which involved organisations from the Energy sector, Production industry, Public and Private sectors.

10.3 SOFT SYSTEMS METHODOLOGY IN TRIANGULATION

The Soft Systems Methodology (SSM) in Triangulation which is a novelty in this action research approach in Lean implementation was successfully used in the enquiry process for continuous improvement in the various organisations that were used as case studies in this research. The SSM in Triangulation used involved a combination of SSM and other qualitative (interviews) and quantitative (survey) approach. This SSM in Triangulation captured a more complete, holistic, and contextual portrayal of the units and systems (organisation) under study.

10.4 LEAN IMPLEMENTATION STUDY IN NIGERIA

This research was also one of the first documented evidence of Lean implementation in organisations in Nigeria. The companies which were identified as 'ENIC (Energy International Company)', 'MET Ltd', 'RNPC', 'PS&D Ltd' and 'SCT Government Agency' for confidential

reasons are all Nigerian organisations located in the Southern, Northern and Middle belt areas of Nigeria. The Lean implementation research in these areas, showed the relative nature of Lean, as the level of 'Leanness' of any organisation is dependent on its location and the resources and social infrastructure available in its environment.

10.5 RESEARCH CONTRIBUTION

This research has;

1. Introduced the Leadership People Process and Output (LPPO) Model of Lean Implementation. The model gives a direct guide for 'starters' on the implementation process and also shows the sequence of key factor intervention at a glance.
2. Presented the use of the Soft Systems Methodology (SSM) in Triangulation for operations and organisational improvement research.
3. Added the Nigerian perspective to the current global study and discuss of the Lean philosophy.

The research has also shown that;

- There is a significant positive relationship between the level of leadership commitment shown and the outcome in lean implementation.
- The level of leadership commitment shown by the Top Management also correlates positively with the level motivation shown by the staff in a lean environment.
- There is also a significant positive relationship between the organisational culture and the success level in terms of outcome from lean implementation.
- There is a significant positive relationship between organisational culture and the level of staff motivation in a lean environment.

- There is a positive relationship between the quality of the human resource (Ability and Competence) in an organization and the success level in terms of outcome from lean implementation.
- There is also a significant positive relationship between the level of workers empowerment and the level of excellence in the processes in a lean environment.
- The level of staff motivation correlates positively with their level of empowerment.
- There is a positive relationship between the level of motivation shown by staffs and their ability and level of competence in a lean environment.

10.6 RESEARCH LIMITATIONS

The findings presented in this study may be limited by the procedure and sequence of use of the Triangulated methods in the enquiry process. The number of organisations used in the study could also be regarded as a limitation and a larger number of organisations are suggested for use in future research. Although the results of the study are interesting and support the theory presented, the limitations of the study should be considered when interpreting or making reference to the findings from this research. Despite these limitations, this study provides additional insights into how the soft systems methodology can be utilised in the implementation of Lean. The developed Lean LPPO implementation model also provides a visible sequential intervention and gives direction on how lean can be implemented which is an improvement on already existing lean implementation models.

10.7 FURTHER STUDY

The effectiveness of the Soft Systems Methodology in Triangulation as a research approach in operations dynamics and organisation sciences should be further tested. The Lean LPPO model should be tried out in a larger scale in Lean deployment. Further study on Lean

organisations should also be carried out to ascertain the relationship between a Lean practicing organisation and its level of awareness and performance of its corporate social responsibility functions in its host community. Finally this research also provides a base for further research work to be carried out on the Lean philosophy, its implementation and benefits in Sub-Saharan Africa.

10.8 SUMMARY

This Chapter gives a brief summary of the novelty of this research which is the Lean 'Leadership, People, Process and Outcome (LPPO) Implementation model and the observed benefits of its use. The Soft Systems Methodology in Triangulation which is also new in the triangulation approach in research methods is also summarised. The Chapter also presents this research work as one of the very few documented evidence of Lean from the Nigerian perspective. Finally, this Chapter gives a conclusion on the research done, findings from the survey, summary of the contribution of the research to the body of knowledge and also state the limitations and areas for further study.

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LIST OF APPENDICES

1. **Sample of the Questionnaire used in the survey**
2. **Research Questions Sourced from Existing Literature**

RESEARCH QUESTIONNAIRE

This questionnaire looks at the processes by which organisations through the optimisation of the inputs of available human and material resources improve their existing systems.

Please tick as appropriate.

Nature of Business	Private	Public	Multinational	National	Others
Industrial Sector	Manufacturing	Oil and Gas	Design and Construction	Services	Others
System Practiced in the Company	Lean Management System	ISO 9000 Quality Management System	Toyota Production System	Just-In-Time Management system	Others
Position	Top Management	Middle Management	Senior Staff	Junior Staff	Others
Qualification	PhD	Masters	BSc	Diploma	Below Diploma
Length in current service	Above 15 years	15 – 11 years	10 - 6 years	5 – 4 years	3 years and below
Total years of Experience	Above 20 years	20 – 15 years	15 -10 years	10 – 5 years	Below 5 years
Age	Above 50 years	50 - 41 years	40 - 31 years	30 – 21 years	20 years and Below
Sex		Male		Female	

Please use the following scales: 1= strongly disagree, 2= disagree, 3= neutral, 4= agree & 5= strongly agree in answering the question by ticking as appropriate.

1. Motives (reasons) for the management system currently being practiced in the company

i.	Quality	1	2	3	4	5
ii.	Efficiency	1	2	3	4	5
iii.	Company image	1	2	3	4	5
iv.	Cutting Waste	1	2	3	4	5
v.	Cost	1	2	3	4	5

2. Leadership

i.	Management develop and communicate clear organization's vision to all	1	2	3	4	5
ii.	Visions are translated into measurable goals for all	1	2	3	4	5
iii.	There are long term plans for achieving these goals	1	2	3	4	5
iv.	Employees are involved in the realization of the goals	1	2	3	4	5
v.	Salary/Pay for Job done is good and it motivates	1	2	3	4	5
vi.	There are regular staff meetings	1	2	3	4	5
vii.	Managers always facilitates the performance of work	1	2	3	4	5
viii.	Workers get support on the job when needed	1	2	3	4	5

3. Influencing factor in the implementation of the current process within the system

i.	Top management	1	2	3	4	5
ii.	Functional managers	1	2	3	4	5
iii.	Supervisors	1	2	3	4	5
iv.	Consultants	1	2	3	4	5
v.	Shop floor technical staff	1	2	3	4	5

4. Target area for improvement in the implementation of the system

i.	Production/Services	1	2	3	4	5
ii.	Human Resources Development	1	2	3	4	5
iii.	Purchasing	1	2	3	4	5
iv.	IT	1	2	3	4	5
v.	Marketing and Sales	1	2	3	4	5
vi.	Finance and Accounting	1	2	3	4	5

5. Challenges and obstacles to the implementation of the system

i.	Lack of adequate finance	1	2	3	4	5
ii.	Lack of IT capabilities	1	2	3	4	5
iii.	Lack of expertise	1	2	3	4	5
iv.	Lack of board & shareholders support	1	2	3	4	5
v.	Lack of adequate communication process	1	2	3	4	5
vi.	Lack of proper organization structure	1	2	3	4	5
vii.	Organization culture	1	2	3	4	5
viii.	Bureaucracy	1	2	3	4	5
ix.	Suppliers	1	2	3	4	5

6. Organizational Culture

i.	People work in Teams	1	2	3	4	5
ii.	There is a strong sense of belonging	1	2	3	4	5
iii.	There is visible cooperation	1	2	3	4	5
iv.	Employees socialize outside office hours	1	2	3	4	5
v.	Work environment is open and friendly	1	2	3	4	5
vi.	Information are widely shared amongst employees	1	2	3	4	5
vii.	There is freedom to perform well	1	2	3	4	5
viii.	Policies are clearly shared and regularly updated	1	2	3	4	5
ix.	Ideas and new concepts are freely suggested and discussed	1	2	3	4	5
x.	Projects are coordinated across departments	1	2	3	4	5

7. Empowerment

i.	There is a high investment on the Training and Development of staff	1	2	3	4	5
ii.	Workers are fully involved in problem solving	1	2	3	4	5
iii.	Workers participate in developing standard operating procedures	1	2	3	4	5
iv.	Workers are involved in tools and process design	1	2	3	4	5
v.	Workers are involved in cross training	1	2	3	4	5
vi.	Workers participate in work planning and decision making	1	2	3	4	5
vii.	Workers take work related decisions	1	2	3	4	5
viii.	Workers interact with customers and suppliers	1	2	3	4	5
ix.	Workers have access to information about quality results	1	2	3	4	5

8. Ability and Competence

i.	People needed for each Job are planned, managed and improved	1	2	3	4	5
ii.	Emphasis is placed on recruiting highly skilled employees	1	2	3	4	5
iii.	People's knowledge and competences are identified, developed and sustained	1	2	3	4	5
iv.	The Level of education is considered in the Job	1	2	3	4	5
v.	Level of previous experience is a consideration for the job	1	2	3	4	5
vi.	Technical skills are of great importance in the job	1	2	3	4	5
vii.	Specific training is needed for the job	1	2	3	4	5
viii.	Extensive training means are provided for staff	1	2	3	4	5
ix.	There is continuous evaluation and performance appraisal	1	2	3	4	5
x.	Doing the job creates more interest	1	2	3	4	5

9. Motivation

i.	The work environment is good	1	2	3	4	5
ii.	The work environment is conducive for the Job	1	2	3	4	5
iii.	The official time for the Job is good	1	2	3	4	5
iv.	Tools for the Job are adequate and enough	1	2	3	4	5
v.	Tools are conveniently located	1	2	3	4	5
vi.	Workers are recognized and rewarded for suggestions and achievement	1	2	3	4	5
vii.	There is Job security	1	2	3	4	5
viii.	Workers are told when they perform well	1	2	3	4	5
ix.	Workers are told when they make mistakes	1	2	3	4	5
x.	I like this Job	1	2	3	4	5

10. The Process

i.	The production /Service processes are visible	1	2	3	4	5
ii.	There is proper house keeping	1	2	3	4	5
iii.	The processes are organised and set in sequential order to minimise all forms of waste	1	2	3	4	5
iv.	The value adding activities are visible	1	2	3	4	5
v.	There is emphasis on waste reduction and elimination	1	2	3	4	5
vi.	Efforts are made to reduce and eliminate rework	1	2	3	4	5
vii.	Processes are designed to prevent employee errors	1	2	3	4	5
viii.	There is emphasis of time saving and time management	1	2	3	4	5
ix.	Efforts are made to reduce set-up time	1	2	3	4	5
x.	Production/ Service delivered is 'pulled' by demand	1	2	3	4	5
xi.	Production/ Service delivered is 'pulled' by delivery of finished goods/ services	1	2	3	4	5
xii.	Quality control measures and specification are constantly communicated	1	2	3	4	5
xiii.	Process capability studies are constantly conducted	1	2	3	4	5
xiv.	There is emphasis on preventive maintenance	1	2	3	4	5
xv.	There are records of routine maintenance	1	2	3	4	5
xvi.	There is constant improvement on the process efficiency	1	2	3	4	5
xvii.	Output per employee is constantly improving	1	2	3	4	5
xviii.	Process time is constantly being improved on	1	2	3	4	5
xix.	There is cost saving from the process	1	2	3	4	5
xx.	Suppliers respond on time	1	2	3	4	5
xxi.	Our suppliers accommodate our needs	1	2	3	4	5
xxii.	Our suppliers meet our specification and quality needs	1	2	3	4	5
xxiii.	Our suppliers are involved in our planning process	1	2	3	4	5
xxiv.	We communicate constantly with our suppliers	1	2	3	4	5
xxv.	We have strong and long term relationship with our suppliers	1	2	3	4	5
xxvi.	We give our supplier's feedback on quality and delivery performance	1	2	3	4	5

11. Outcome and feedback

i.	We communicate constantly with our customers	1	2	3	4	5
ii.	Our customers give us feedback on quality and delivery performance	1	2	3	4	5
iii.	Our customers frequently share current and future demand information with us	1	2	3	4	5
iv.	We regularly conduct customer satisfaction surveys	1	2	3	4	5
v.	We give feedback on each job we do for future improvement	1	2	3	4	5
vi.	Our equipments/ processes are under statistical process control	1	2	3	4	5
vii.	There is extensive use of statistical technique to reduce process variance	1	2	3	4	5
viii.	Charts showing defects rates are constantly being used	1	2	3	4	5
ix.	Charts showing performance are constantly being used	1	2	3	4	5
x.	We continuously strive for quality	1	2	3	4	5
xi.	Our system is efficient	1	2	3	4	5
xii.	The processes we use are effective	1	2	3	4	5
xiii.	Our system allows for continuous improvement in quality and in our processes	1	2	3	4	5

RESEARCH QUESTIONS SOURCED FROM EXISTING LITERATURE

1. Leadership questions

i.	Management develop and communicate clear organisation's vision to all	1	2	3	4	5
ii.	Visions are translated into measurable goals for all	1	2	3	4	5
iii.	There are long term plans for achieving these goals	1	2	3	4	5
iv.	Employees are involved in the realization of the goals	1	2	3	4	5
v.	Salary/Pay for Job done is good and it motivates	1	2	3	4	5
vi.	There are regular staff meetings	1	2	3	4	5
vii.	Managers always facilitates the performance of work	1	2	3	4	5
viii.	Workers get support on the job when needed	1	2	3	4	5

Question i, is same as question LI3 from the questionnaire used in Peng, Schroeder and Shah (2008). Question iii is also related to question ST1 used in Peng et al. (2008). Question vii and viii are reflections from the questions used in Terziovski and Samson (1999), Bou-Llusar, Escrig-Tena, Roca-Puig and Beltran-Martin (2009) and the proposition on work facilitation and the lean philosophy by de Treville and Antonakis (2006).

2. Organisational Culture questions

i.	People work in Teams	1	2	3	4	5
ii.	There is a strong sense of belonging	1	2	3	4	5
iii.	There is visible cooperation	1	2	3	4	5
iv.	Employees socialize outside office hours	1	2	3	4	5
v.	Work environment is open and friendly	1	2	3	4	5
vi.	Information are widely shared amongst employees	1	2	3	4	5
vii.	There is freedom to perform well	1	2	3	4	5
viii.	Policies are clearly shared and regularly updated	1	2	3	4	5
ix.	Ideas and new concepts are freely suggested and discussed	1	2	3	4	5
x.	Projects are coordinated across departments	1	2	3	4	5

People working in teams or in groups are one of the cultural practises in Lean. Cross functional teams formed to solve problems (Boyer, 1996). Question i seek to answer this question and it is the same as the question used in 3c5 in Bou-Llusar et al. (2009).

3. Empowerment questions

i.	There is a high investment on the Training and Development of staff	1	2	3	4	5
ii.	Workers are fully involved in problem solving	1	2	3	4	5
iii.	Workers participate in developing standard operating procedures	1	2	3	4	5
iv.	Workers are involved in tools and process design	1	2	3	4	5
v.	Workers are involved in cross training	1	2	3	4	5
vi.	Workers participate in work planning and decision making	1	2	3	4	5
vii.	Workers take work related decisions	1	2	3	4	5
viii.	Workers interact with customers and suppliers	1	2	3	4	5
ix.	Workers have access to information about quality results	1	2	3	4	5

Boyer (1996) asserted that training and development as an essential infrastructural investment in Lean. Question ii and v are related to the questions used in Shah and Ward (2007). Question vii and ix are the same as the questions used in 3c3 and 3d3 in Bou-Llusar et al. (2009).

4. Ability and Competence questions

Questions i, ii, iii vii and viii are related to the questions used in 3a and 3b in Bou-Llusar et al. (2009).

i.	People needed for each Job are planned, managed and improved	1	2	3	4	5
ii.	Emphasis is placed on recruiting highly skilled employees	1	2	3	4	5
iii.	People's knowledge and competences are identified, developed and sustained	1	2	3	4	5
iv.	The Level of education is considered in the Job	1	2	3	4	5
v.	Level of previous experience is a consideration for the job	1	2	3	4	5
vi.	Technical skills are of great importance in the job	1	2	3	4	5
vii.	Specific training is needed for the job	1	2	3	4	5
viii.	Extensive training means are provided for staff	1	2	3	4	5
ix.	There is continuous evaluation and performance appraisal	1	2	3	4	5
x.	Doing the job creates more interest	1	2	3	4	5

5. Motivation questions

According to Pinder (1984) and de Treville and Antonakis (2006), "work motivation is a set of energetic forces that originate both within as well as beyond an individual's being, to initiate work-related behaviour, and to determine its form, direction, intensity, and duration". De Treville and Antonakis (2006) further suggested that a configuration of lean philosophical practices is very important for workers motivation. Among these practices is

the job design, the job environment, job compensation, job security and the level of autonomy allowed. The questions on motivation based on literature and observations are set out to establish the level of the organisation concurrence researchers' assertion on workers motivation in a Lean environment (De Treville and Antonakis, 2006; Liker, 2004 and 2008; Shah and Ward, 2003 and 2007; Womack et al., 1990).

i.	The work environment is good	1	2	3	4	5
ii.	The work environment is conducive for the Job	1	2	3	4	5
iii.	The official time for the Job is good	1	2	3	4	5
iv.	Tools for the Job are adequate and enough	1	2	3	4	5
v.	Tools are conveniently located	1	2	3	4	5
vi.	Workers are recognized and rewarded for suggestions and achievement	1	2	3	4	5
vii.	There is Job security	1	2	3	4	5
viii.	Workers are told when they perform well	1	2	3	4	5
ix.	Workers are told when they make mistakes	1	2	3	4	5
x.	I like this Job	1	2	3	4	5

Question vi is related to expression used in question 3e in Bou-Llusar et al. (2009).

6. Process Excellence questions

Questions on process excellence looks at the tell tale signs of continuous improvement actions, activities and processes within the lean practicing organisation.

i.	The production /Service processes are visible	1	2	3	4	5
ii.	There is proper house keeping	1	2	3	4	5
iii.	The processes are organised and set in sequential order to minimise all forms of waste	1	2	3	4	5
iv.	The value adding activities are visible	1	2	3	4	5
v.	There is emphasis on waste reduction and elimination	1	2	3	4	5
vi.	Efforts are made to reduce and eliminate rework	1	2	3	4	5
vii.	Processes are designed to prevent employee errors	1	2	3	4	5
viii.	There is emphasis of time saving and time management	1	2	3	4	5
ix.	Efforts are made to reduce set-up time	1	2	3	4	5
x.	Production/ Service delivered is 'pulled' by demand	1	2	3	4	5
xi.	Production/ Service delivered is 'pulled' by delivery of finished goods/ services	1	2	3	4	5
xii.	Quality control measures and specification are constantly communicated	1	2	3	4	5
xiii.	Process capability studies are constantly conducted	1	2	3	4	5
xiv.	There is emphasis on preventive maintenance	1	2	3	4	5
xv.	There are records of routine maintenance	1	2	3	4	5
xvi.	There is constant improvement on the process efficiency	1	2	3	4	5
xvii.	Output per employee is constantly improving	1	2	3	4	5
xviii.	Process time is constantly being improved on	1	2	3	4	5
xix.	There is cost saving from the process	1	2	3	4	5
xx.	Suppliers respond on time	1	2	3	4	5
xxi.	Our suppliers accommodate our needs	1	2	3	4	5

xxii.	Our suppliers meet our specification and quality needs	1	2	3	4	5
xxiii.	Our suppliers are involved in our planning process	1	2	3	4	5
xxiv.	We communicate constantly with our suppliers	1	2	3	4	5
xxv.	We have strong and long term relationship with our suppliers	1	2	3	4	5
xxvi.	We give our supplier's feedback on quality and delivery performance	1	2	3	4	5

Questions ix, x, xi, xiii, xx, xxiv, xxv and xxvi are to a great extent same as the questions used in Setup_01, Pull_02, Pull_01, SPC_05, SuppJIT_02, Suppfeed_01, Suppfeed_05 and Suppfeed_04 in Shah and Ward (2007).

7. Questions on Outcome and feedback from lean implementation

The question in this section expresses the fact that what is achieved tend to encourage further implementation and general sustenance of the philosophy within any system. Questions i, ii, iii, vi, vii and viii are to a great extent same as the questions used in Custinv_01, Custinv_03, Custinv_06, SPC_01, SPC_02 and SPC_03 in Shah and Ward (2007).

i.	We communicate constantly with our customers	1	2	3	4	5
ii.	Our customers give us feedback on quality and delivery performance	1	2	3	4	5
iii.	Our customers frequently share current and future demand information with us	1	2	3	4	5
iv.	We regularly conduct customer satisfaction surveys	1	2	3	4	5
v.	We give feedback on each job we do for future improvement	1	2	3	4	5
vi.	Our equipments/ processes are under statistical process control	1	2	3	4	5
vii.	There is extensive use of statistical technique to reduce process variance	1	2	3	4	5
viii.	Charts showing defects rates are constantly being used	1	2	3	4	5
ix.	Charts showing performance are constantly being used	1	2	3	4	5
x.	We continuously strive for quality	1	2	3	4	5
xi.	Our system is efficient	1	2	3	4	5
xii.	The processes we use are effective	1	2	3	4	5
xiii.	Our system allows for continuous improvement in quality and in our processes	1	2	3	4	5